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THE UNIVERSITY OF ALBERTA

STABILIZATION OF PRICE, QUANTITY AND GROSS INCOME FOR HOG PRODUCERS

by

© JAN A. VAN EGTEREN

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

DEPARTMENT OF RURAL ECONOMY

EDMONTON, ALBERTA

FALL, 1976

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read and recommend to the Faculty of Graduate Studies for acceptance a thesis entitled "Stabilization of Price, Quantity and Gross Income for Hog Producers," submitted by Jan A. van Egteren in partial fulfilment of the requirement for the degree of Master of Science.

Michele Veeman
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Date Aug. 3, 1976

ABSTRACT

Hog production in Alberta and indeed, Canada, has recently fallen to very low levels, while hog prices, after reaching record high levels, are now again on the decline. Hog producers have traditionally marketed excess grain in the form of hogs, but with the world-wide tight grain outlook, feed input prices have become very volatile. In total, the hog producer is faced with tremendous uncertainty and production decisions are extremely difficult.

Given these conditions, producers, meat packers, retailers, consumers and governments are justifiably concerned with the problem of stabilizing hog production. The existence of this study is further justified by the fact that there has been little effort to quantitatively study the effects and effectiveness of hog stabilization programs in Canada.

The primary objective of this study was to empirically determine the major source of hog producers' income variability and to attempt to ascertain the effects of some recent hog stabilization programs. These objectives were pursued using identity variance apportionment analysis and by estimating a number of hog price supply elasticities and "value-added" elasticities for Canada, Alberta, Eastern Canada and Western Canada. In addition some of the theoretical aspects of stabilization were explored to provide a backdrop against which stabilization programs could be examined.

The primary finding of this study was that the major cause of hog producers' income variability over the years has been price variability, while the major cause of hog producers' weekly income variability has been quantity fluctuations. The implication of this finding is that a stabilization policy which lasts over a number of years should

concentrate on stabilizing hog prices. In addition, it is conceivable that a program which was able to reduce the variability of the flow of hog supplies to the market within a year would possibly reduce marketing costs by allowing processors to schedule their killing more efficiently and to reduce the need for storage.

This study also found that price may not be a major consideration for Western Canadian and Alberta hog producers when making production decisions. It was found that the coefficients for hog prices estimated by the least squares estimation procedure in Alberta and Western Canada were statistically not significantly different from zero. The implication of this finding is that while a price stabilization program in Alberta and Western Canada may directly stabilize gross income it may not stabilize hog supplies, and therefore may not indirectly stabilize gross income from hog production.

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CHAPTER 1

INTRODUCTION

The Problem

One of the major problems facing the hog producing industry in Canada is that market supply, prices and input costs, and in particular, feed costs, fluctuate. Figures 1.1 and 1.2 illustrate the magnitude of hog price fluctuations for index 100 hogs in two representative markets in Canada. In Toronto, prices dropped to $39/cwt. in June of 1974. By the end of 1974, the price in Toronto had risen by 50 percent over the June price to $59/cwt. Six months later, the price had only risen to $60/cwt., but it had fallen to $50/cwt. during the interim.

Figure 1.3 illustrates that the magnitude of the hog supply fluctuations were substantial. In 1975, however, hog production was 14 percent less than hog production in 1974. Presumably, this reduction in supply brought about the substantially higher prices experienced between March 1975 and the end of 1975.

In addition to the uncertainty caused by fluctuating hog prices, producers are faced with widely fluctuating input costs. In 1974 and 1975, in Winnipeg, barley varied in price from $2.17 per bushel to $3.24 per bushel.[1]

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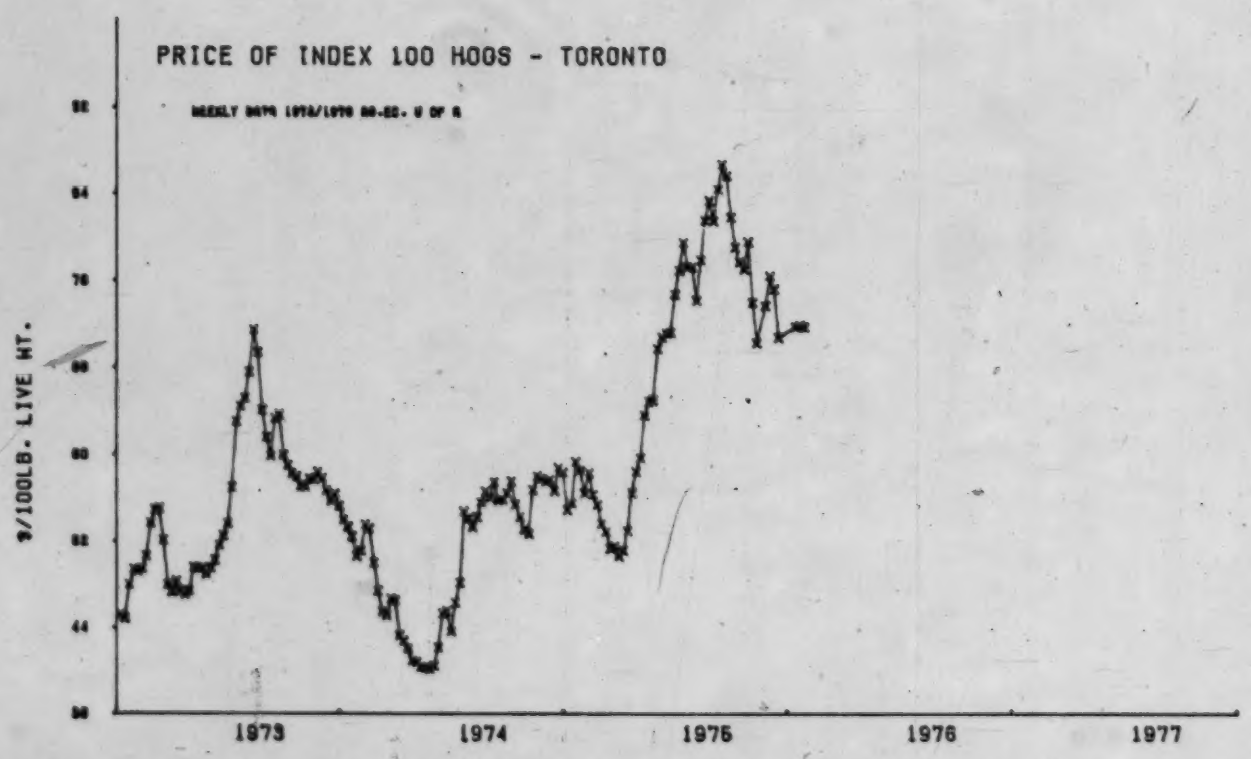
[1] Canadian Grain Commission, Grain Statistics Weekly, (1974, 1975), various issues. In Chapter IV the degree of price, supply and income variation is measured using the coefficient of variation, the coefficient of variation corrected for trend and the instability index.

Figure 1.1

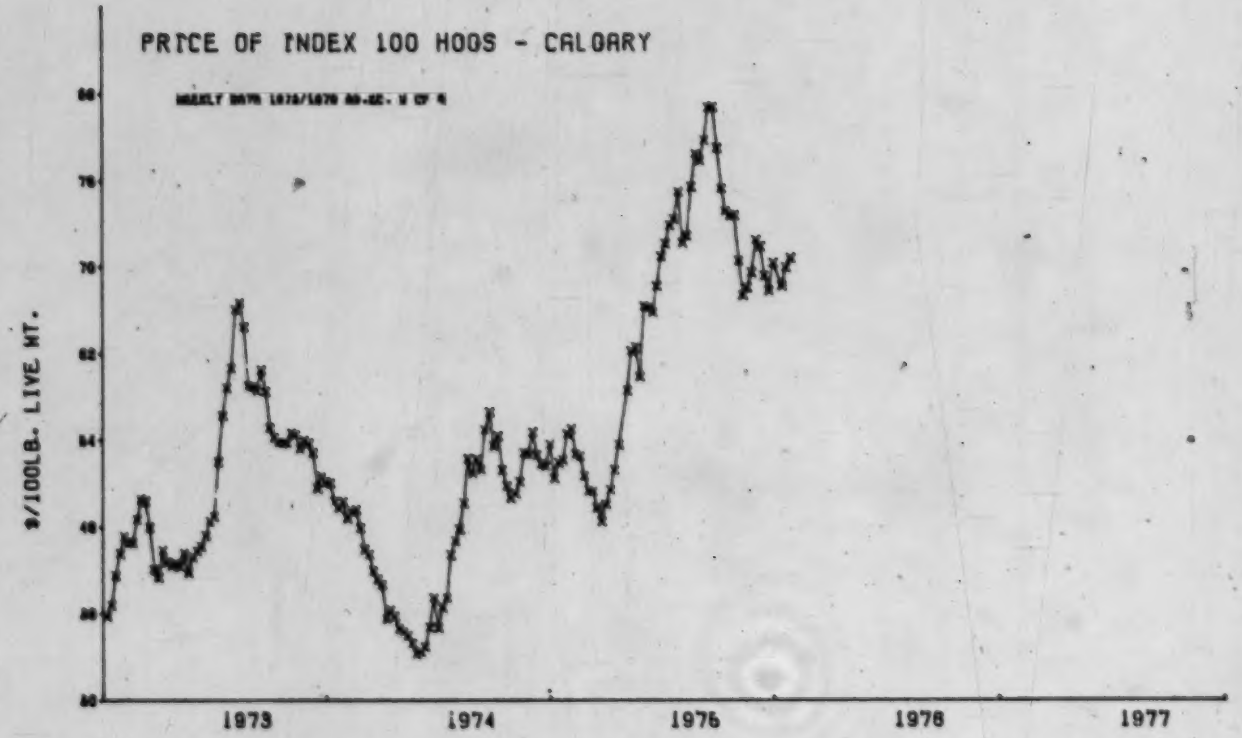
PRICE OF INDEX 100 HOGS - TORONTO



Source: Data Obtained from Agriculture Canada, Canada Livestock and Meat Trade Report (Ottawa Markets Information Service, various issues, 1973 - 1976).

Figure 1.2

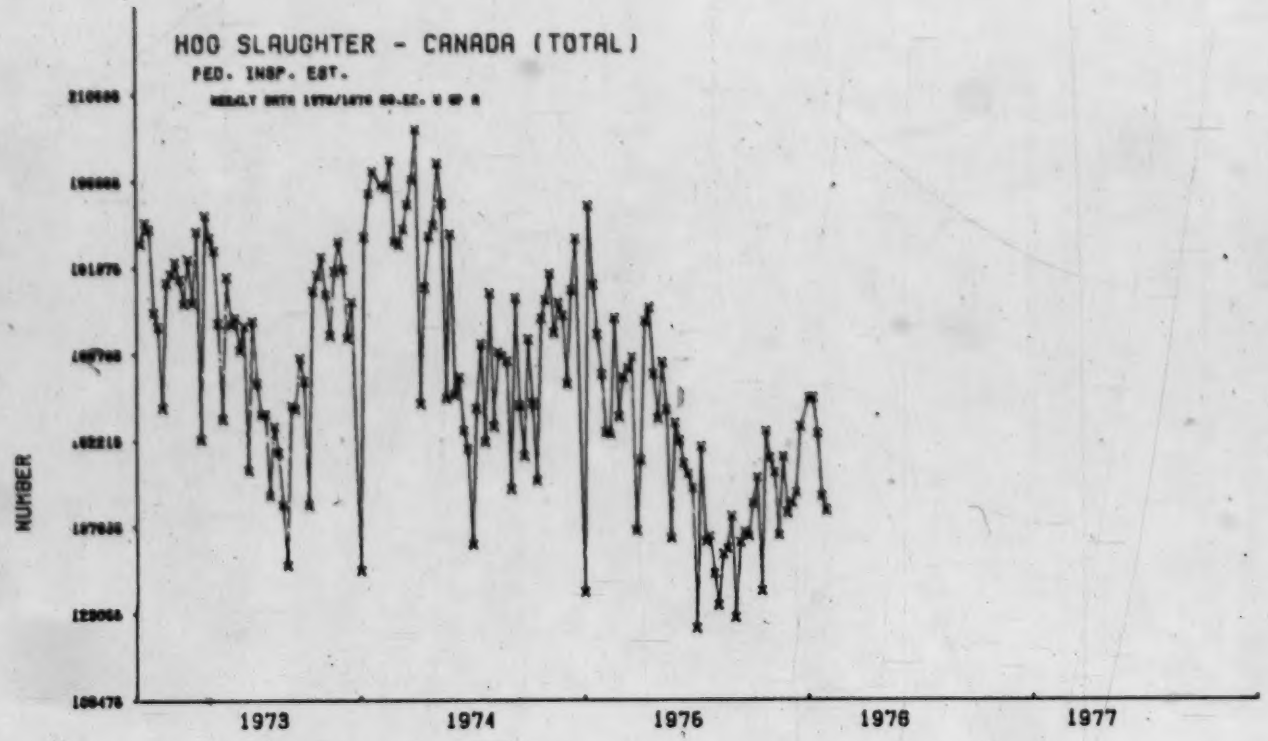
PRICE OF INDEX 100 HOGS - CALGARY



Source: Data obtained from Agriculture Canada, Canada Livestock and Meat Trade Report (Ottawa Markets Information Service, various issues, 1973 - 1976).

Figure 1.3

FEDERALLY INSPECTED HOG SLAUGHTER - CANADA



Source: Data obtained from Agriculture Canada, Canada Livestock and Meat Trade Report (Ottawa Markets Information Service, various issues, 1973 - 1976).

The General Manager of the Alberta Hog Producers' Marketing Board has expressed the problem in this manner:

> Recently, financial experts and farmers alike have been viewing with growing alarm, the wild boom and bust cycle in hog production. In August we had a "boom" and in February a "bust". Hog producers are on the verge of making a fortune in August and in February were facing financial ruin. What will it be six months down the road? It is becoming extremely difficult - in fact almost impossible, to predict changes in the farm economic cycle. It is obvious that a committed hog producer cannot function in the face of so much uncertainty.[1]

Objectives

The objectives of this study are the following:

1) To ascertain the degrees of variability in hog prices, quantities produced and gross income in Canada, Alberta, Eastern Canada, and Western Canada annually for the period 1950 to 1973 and weekly for the period 1973 and 1974.

2) To ascertain whether the major source of variability in aggregate income is price variability or supply variability, for the same regions and time periods as in 1.

3) To analyze various recent stabilization programs to ascertain their effect on income.

Hypotheses

Until very recently demand for hogs and pork in Canada, could be filled by domestic supplies and supplies from the United States. Thus, changes in domestic supply should illicit only a small change in price. Accordingly, the hypotheses which this

---

[1] Ed Schultz, "Editorial: Boom and Bust or Stabilization", Alberta Hog Journal, Vol. 3, No. 2 (Spring, 1974), p. 4.

study tests are:

1) That fluctuations in gross income from hog production have been caused, for the most part, by supply variability.

2) That hog stabilization programs have basically been price support programs and have not been truly stabilizing.

3) That hog stabilization programs have generally been ineffective because they have concentrated on stabilizing price whereas supply variability has been the major cause of gross income variability.[1]

Scope and Methodology

This study is based upon analysis of weekly, quarterly and annual secondary data collected primarily for hogs, and analysis of weekly and annual secondary data for barley, wheat, cattle and calves. The annual and weekly data variability analyses for barley, wheat, cattle and calves were undertaken to enable comparisons with the variability analysis for hogs.

The annual and weekly data were analyzed to obtain a measure of the degree of variability of price, supply and gross income. The annual data covered twenty-four years, 1950 to 1973, while the weekly data covered 1973 and 1974. Utilizing the annual and weekly data facilitated a comparison of the long-run and short-run variability.

The method of measuring the variability of price, supply

---

[1] Price stabilization programs may indirectly stabilize income as stabilizing price will stabilize supply variability and the programs effectiveness will be dependent on the price elasticity of supply. This topic is discussed in Chapter V.

(quantity) and gross income was to use the coefficient of variation corrected for trend, the coefficient of variation and an instability index. The degree of variability was measured in percentages and therefore, comparisons of variability among variables of different units were possible.

From the quarterly data, hog supply functions were estimated for Canada, Alberta, Eastern Canada and Western Canada. These supply functions were used to estimate a series of price and "value-added" supply elasticities.[1] The elasticities were helpful in evaluating the effect of three recent stabilization and price support programs.

The supply functions were estimated using the ordinary least squares technique following a Koyck transformation of the proposed function. The Koyck transformation was necessary in view of the fifteen to eighteen month lag which usually applies between the time a production decision is made and the time when this decision manifests itself in the market.

Organization of the Study

This study is organized as follows: Chapter II will provide a description of three Canadian stabilization and price support programs. Chapter III will review some of the theoretical and applied literature pertaining to various aspects of agricultural sta-

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[1] For this study, "value-added" is taken as the variable applied by the Federal hog stabilization program and is defined as the per hundredweight index 100 hog price minus the per hundredweight of gain feed cost. The calculation of the variable is detailed in Chapter V.

bilization. Chapter IV measures the degree of variability of prices, supply and gross income for hogs, cattle and calves, wheat and barley annually from 1950 to 1973 and weekly from 1973 to 1974. Chapter IV also provides estimates of the relative contributions of price and supply variability to gross income variability. It was found, for example, that over the twenty-five years, price variability contributed 75 percent of the variability in gross income of hog producers in Canada. In contrast, the weekly analysis showed that supply variability contributed 56 percent of the variability in hog producers' gross income in Canada.

Chapter V presents estimates of the regional hog supply functions for Canada, Alberta, Eastern Canada and Western Canada. It was found, for example, that price was generally not a "good" explanatory variable. This lent support to the hypothesis that price stabilization programs have little effect on stabilizing supply and thus, gross income. Chapter V also presents estimates of price and "value-added" supply elasticities. It was found that a percentage change in price times the percentage change in supply, estimated using the price elasticity of supply, which is equal to the percentage change in gross income was generally small for all regions in Canada.

Chapter VI contains the summary and recommendations. Based on the analysis in the chapters preceding Chapter VI, the recommendations dealt with ways to improve stabilization programs and other areas of research. It was recommended that hog stabilization programs be longer than one year in duration since price

seems to be the major contributor to gross income variability over a period of years. In addition, it was recommended that hog stabilization programs take into account changes in the major input costs such as feed. It was felt that feed costs could vary sufficiently in a three-month period to warrant an adjustment in the stabilization program. That is, a stabilization program should review input costs every quarter, and should adjust the base and ceiling price accordingly.

CHAPTER II

STABILIZATION AND CANADIAN HOG PROGRAMS

Introduction

Many discussions of stabilization have been couched in a number of somewhat ill-defined terms and phrases. Exactly what the term stabilization means may differ among a group of individuals and thus their criteria for evaluation of a policy program designed as a "stabilization" measure may differ as well. For example, a consumer may evaluate a stabilization program by looking at the effect of the policy on the increase in retail prices for the particular commodity in question. A packing plant official, on the other hand, may evaluate a stabilization program on the basis of its effect on availability of supplies. Thirdly, a producer may evaluate a stabilization program on the basis of whether or not the program has raised his disposable income.

As a result, it was necessary to provide a sufficiently exact definition of stabilization in order to facilitate the following analysis of the subject in relation to hog producers. Therefore, for this study stabilization was defined as the reduction of the amplitude of variation of a particular variable or variables. The variables of primary concern in this study were hog producers' income and hog price.

Obviously, hog producers' income variability was caused, in part, by hog price variability. There were also a number of other variables which might have caused income variability and there could have been a number of different programs to stabilize hog producers'

incomes. Both of these areas, sources of income instability and stabilization programs, are outlined in the following portions of this chapter.

Sources of Income Instability

Gross income instability for hog producers may be thought of as being caused by either hog price variability, hog supply variability, or both.[1] If price and quantity vary in the same direction at the same time over a time series, then the variability in gross income will be some multiple of the variability of price and supply. If one of the variables is constant, then gross income variability should be approximately equal to the variability of the other variable. If the price and quantity variables vary in the opposite directions at the same time and to the same extent, then gross income should be approximately constant.

If net income is the variable to be stabilized, then more variables than price and quantity must be taken into consideration. Input costs, such as that for feedgrains, must be considered an influence. In addition, the variability of institutional factors such as income taxes must be considered, as well as the variability in marketing costs. This study concentrated on price, quantity and feed cost variability in relation to gross income and net income variability.

For each of the variables contributing to producer income variability, there are a number of contributing factors. In general,

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[1] Hog supply variability, in turn, can be caused by either numbers of hogs produced variability or the weight of hogs produced variability or both. This study concerned itself solely with number of hogs produced variability.

price, quantity and input cost variability are made up of four factors. These are:

1) seasonal variance,
2) cyclical variance,
3) a trend, and
4) random irregularities.

These are essentially the components of any time series variability and all are somewhat interrelated among the specific variables.[1]

A trend is not usually considered as a source of variability. "Rather, it is a measure of the directional movement in a series over a long period of time."[2] A trend is either increasing, decreasing or constant over a period of time. Thus price can be said to have an upward trend if the number of observations above horizontal norm is greater than the number of observations below the horizontal norm. The opposite is true for a decreasing or downward trend.

Some variability in income may be caused by what is called "the hog cycle". This relates to the periodic rise and subsequent decline in the number of hogs slaughtered. This cycle usually follows a fairly regular pattern.

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[1] For other discussions of variability in the hog industry in Canada, see: T. M. Petrie, Seasonal, Cyclical and Trend Variations in the Hog Industry Summary, Economics Branch Publication No. 74/20 (Ottawa: Agriculture Canada, November 1974); T. M. Petrie and A. G. Wilson, Discussion paper on Seasonal, Cyclical and Trend Variations in Hog Prices and Numbers Slaughtered, Economics Branch Publication No. 74/13 (Ottawa: Agriculture Canada, July 1974); and also D. A. West and H. W. Smith, "Instability in the Hog-Pork Industry", Canadian Farm Economics, Vol.8, No.2 (April 1973).

[2] Petrie, Op. Cit., p. 1.

A number of explanations of the hog cycle have been postulated. However, commodity cycles usually are due to the lag involved between making a production decision, based on an expected profitability criteria, and the market manifestation of this production decision.

There are very definite seasonal variations in prices and quantities of many commodities and these may be based on regular seasonal supply movements, demand movements or the relative movements of both supply and demand. For example, there may be an annual rise in hog prices in certain months of the year due to decreased supply, coupled with constant demand being associated with those months.

Finally, irregular or sporadic variations may arise due to shifting exogenous factors. A good example of this occurred in 1974-75 when Canada and the United States closed their respective borders to the flow of beef, pork, eggs and other commodities. For the pork sector this incident may have been the cause of some variability in price, supply or income.

Methods for the Reduction of Instability

There are two broad alternatives which can be utilized to reduce the amount of variability in prices, supplies, input costs and income. Generally, these alternatives can be categorized as:

1) market intervention, and
2) non-market intervention.

Market Intervention

Market intervention refers to the actual manipulation of the market or market variables in order to reduce the amplitude of fluctuations of these market variables. Intervention into the market may

take the form of a government or government agency reducing supplies in order to reduce the downward fluctuations in the price of that commodity. In other words, market intervention measures adjust price, supply or demand.

Some possible programs which can be market intervention alternatives are:

1) buffer fund programs,
2) buffer stock programs,
3) deficiency payment programs which might be applied using:

    i. a simple price guarantee,
    ii. an indexed price guarantee, and
    iii. a margin guarantee.

Non-Market Intervention

Non-market intervention refers to all programs which do not specifically manipulate quantity supplied, quantity demanded, or price, although they may indirectly affect these variables in the long run. Examples of non-market intervention programs are:

1) income tax averaging,
2) interest free loans,
3) progressive income tax, and
4) incentive grants for quality.

In this study, the main focus is on market interventionist programs.

Examples of Possible Canadian Market Intervention Programs

Buffer Fund Program

This type of program involves the withholding of producer revenue when prices, and consequently revenue, are high and releasing these funds when prices are low. Essentially, a buffer fund program is a forced savings program.

There has never been a pure buffer fund program in Canada.

This is apparently due to the fact that governments have invariably felt obliged to contribute to the fund and an income support program, rather than a pure buffer fund program, results.

At the present time the Maritimes have a "buffer fund" type of program in operation although the provincial governments do contribute to the fund under certain prescribed conditions. The following is a brief description of the Prince Edward Island stabilization scheme which is part of the Maritimes scheme.

P.E.I. Hog Stabilization Program

On July 7, 1975, the P.E.I. Government entered into an agreement with the Prince Edward Island Hog Commodity Marketing Board with respect to the operation of the hog stabilization program. The agreement requires that the Marketing Board establish the producers' responsibilities and commitments to the program and that these commitments, such as producer contributions to the fund, be evaluated and amended quarterly. The Board also has authority over producer eligibility, producer equity and other relevant matters regarding producers.

If the fund into which producers contribute is below $250,000 and the hog market price is below $55/cwt., the provincial government is required to make contributions in the form of grants of up to one-half of the difference between the stabilization base price ($55/cwt.) and the weekly market price as established by the Board. If market price is less than $55/cwt., but the fund is greater than $250,000, then the fund alone makes the payments.

Producer contributions to the fund are 50¢ per animal for every dollar the market price exceeds $60/cwt. up to a maximum of $3

per pig. Over $65/cwt. there is no increase in payment. From information obtained from the P.E.I. government, it was found that if the fund is not greater than $500,000, then producer payments are as illustrated below.

Table 2.1

PRODUCER PAYMENTS INTO THE BUFFER FUND IF THE FUND BALANCE IS LESS THAN FIVE HUNDRED THOUSAND DOLLARS

Market Price	Producer Payment
$60.00 - $60.99/cwt.	$0.50
$61.00 - $61.99/cwt.	$1.00
$62.00 - $62.99/cwt.	$1.50
$63.00 - $63.99/cwt.	$2.00
$64.00 - 64.99/cwt.	$2.50
$65.00 - and over	$3.00

If the fund is greater than $500,000, producer contributions are reduced by half. If market prices are between $55.00 and $59.99/cwt., there is no payment or producer contribution.

This base figure, as mentioned previously, is adjusted quarterly and is done so according to the movement of the following indices:

1) feed (10)
2) weaner pigs (20)
3) labor (4)
4) interest (3)
5) building repairs (3)

The percentage weightings of the input adjustment procedure are given in the brackets.

This type of stabilization program is a buffer fund program in that it attempts to "lop-off" some of the highs and lows of prices

while maintaining the price trend above the costs of production.

Buffer Stock Program

A buffer stock program involves the withdrawal of part of the market supply when prices are low and the reintroduction of a certain quantity of the commodity in question to the market supply when market supplies are low. A related support, rather than stabilization,program which is intended to maintain minimum but not maximum price levels, is an offer-to-purchase program. Here a government agency enters the market to purchase supplies of a commodity to maintain the market price at a certain prescribed level. A true buffer stock program would be an extension of an offer-to-purchase program in that a maximum level price is specified as well as a minimum price level. At the maximum price level the agency would release all or part of the supplies purchased earlier and so maintain the ceiling price level.

Agricultural Stabilization Board

There has never been a true buffer stock program in Canada. The Agricultural Stabilization Board has the power to operate an offer-to-purchase program. The Board may operate the program for hogs as well as for other commodities.

The Agricultural Stabilization Board, created under the Agricultural Stabilization Act of 1958, was given increased supportive capabilities in 1975 through amendments to the Stabilization Act. The Act now provides the Board with the power to monitor the prices of various commodities, including hogs, and when the weighted market price falls below 90 percent of the five year moving average of prices, it

may recommend to Cabinet a plan to "stabilize" the prices received by producers. In addition, the support level price is now indexed to take into account the changes occurring in farm input costs.

If the weighted average market price does fall below the support level price, the Board may recommend a purchase program to maintain prices at the support level. The proposal for the plan must provide the approximate amounts to be purchased to maintain prices. as well as the cost of the program which includes such things as storage costs, purchase costs, and processing costs. The plan is administered by the Board but the actual operation of the Agricultural Stabilization Board purchase programs are often awarded by a tendered contract to a private firm.

A recent purchase program operated by the Board was the Beef Loaf Purchase program of 1975. This program allowed for the purchase of domestic beef cows to support the market price. The cow beef was bought and processed by a private firm and the beef loaf was sold by the Stabilization Board to the Canadian International Development Agency for disposal as foreign aid. This program is illustrative of the fact that supplies that are bought on the domestic market to maintain a minimum price level are never returned to the market when prices have risen. Thus, the purchase programs operated by the Board have typically become price support programs rather than stabilization programs in the true sense of the word.

Deficiency Payment Program

Deficiency payment programs, and for that matter price support programs, are not true stabilization programs like the buffer stock and buffer fund programs. Rather, a deficiency payment program is a

support program due to the fact that only downward fluctuations of prices are reduced. The features that make deficiency payment or price support programs attractive to policymakers are their relative ease of implementation and their political acceptability.

Recently, the typical deficiency payment program operated by the Agricultural Stabilization Board was modified in an attempt to reduce the downward fluctuations in producer profits. This was done by taking into account not only hog price fluctuations but also input cost fluctuations. The Federal Government's hog stabilization plan, which ran from April 1, 1974, to March 31, 1975, was the first attempt at stabilizing the margin between hog prices and hog feed costs.

Hog Margin Stabilization Program

Essentially this program operated in the following manner. A margin of $22.41/cwt., or $37 per hog, was guaranteed to producers for the year. The margin guaranteed represented 90 percent of the five year margin, from April 1, 1969, to March 31, 1974, by which hog prices had exceeded wholesale feed costs, based on a 13 percent protein ration and a constant feed conversion ratio. The margin was guaranteed for all index 88 hogs or better, up to a maximum of 1500 hogs per establishment. If at the end of the year the average of the market prices minus feed cost inputs was less than $22.41/cwt., the Government would make a deficiency payment to make up the difference.

When the program ended, no payments were made due to the fact that the price of hogs had remained sufficiently high to maintain the cumulative margin for the year well above the guaranteed margin of $22.41/cwt. Table 2.2 shows the weekly development of the

program. As of August 24, 1974, it can be seen that the cumulative weighted margin was remaining substantially above the guaranteed margin.

Summary

It is obvious at this point that agricultural stabilization measures have been, in reality, support programs rather than true stabilization programs. Since these programs have involved price and income support, there is a definite possibility of a supply response which may subsequently lead to depressed prices and perhaps even to greater fluctuations in producer incomes. The Beef Loaf program was a short-term price support measure, the Maritime Hog Stabilization plan is a support program and the Federal Government Hog Margin program was a short-term support measure. The Maritime program along with the Beef Loaf program may have detrimental long-run consequences.

In the following chapters the theoretical basis of stabilization is explored, the amount of price, supply and total revenue variability for hog producers is explored, and the possible effects of stabilization measures are quantitatively explored. The next Chapter deals with the theoretical aspects of stabilization.

Table 2.2

WEEKLY REPORT ON HOG MARGINS - 1974-75

Week Ending	Nationally Weighted Feed Grain Cost ($/cwt. of pork)	National Pork Price ($/cwt. of pork)	Weekly Margin ($/cwt. of pork)	Weekly Hog Slaughter Index 88 & up	Cumulative Weighted Margin
6 April	18.87	43.28	24.41	173,895	24.41
13 April	19.26	40.62	21.36	135,126	23.08
20 April	19.67	40.75	21.08	161,073	22.39
27 April	19.94	40.28	20.34	159,440	21.87
4 May	19.98	39.07	19.09	160,595	21.31
11 May	20.31	38.88	18.57	170,572	20.82
18 May	20.44	38.25	17.81	163,924	20.38
25 May	20.73	38.24	17.51	138,082	20.07
1 June	20.61	37.89	17.28	160,705	19.75
8 June	20.12	38.17	18.05	140,266	19.60
15 June	20.05	39.74	19.69	142,468	19.61
22 June	20.13	42.30	22.17	133,813	19.79
29 June	19.76	42.27	22.51	132,105	19.98
6 July	19.17	40.73	21.56	118,627	20.07
13 July	19.56	43.18	23.62	138,414	20.29
20 July	19.47	44.11	24.64	145,241	20.56
27 July	19.64	47.41	27.77	148,879	20.98
3 August	19.28	49.25	29.97	148,347	21.48
10 August	19.41	49.88	30.47	133,574	21.91
17 August	19.33	51.19	31.86	146,272	22.40
24 August	18.12	53.10	34.98	145,309	22.99
31 August	18.05	54.04	35.99	145,797	23.57
7 September	18.41	53.86	35.45	126,838	24.02
14 September	18.19	54.91	36.72	156,755	24.59
21 September	18.99	54.87	35.89	139,919	25.02
28 September	18.91	55.88	36.97	132,950	25.44
5 October	19.19	54.78	35.59	148,148	25.82
12 October	19.87	55.61	35.74	139,237	26.15
19 October	20.56	54.01	33.45	128,017	26.38
26 October	22.57	52.10	29.53	149,073	26.48
2 November	22.26	50.90	28.64	150,247	26.56
9 November	22.33	50.86	28.53	154,397	26.62
16 November	22.83	53.20	30.37	146,318	26.74
23 November	23.50	55.01	31.51	148,936	26.88
30 November	23.09	55.51	32.42	126,507	27.02
7 December	22.95	55.11	32.16	108,637	27.12
14 December	23.35	55.69	32.34	154,654	27.27
21 December	22.40	54.42	32.02	165,767	27.42
28 December	23.17	56.18	33.01	65,283	27.48
5 January	23.87	56.15	32.28	111,354	27.58
12 January	23.67	53.10	29.43	159,609	27.63
19 January	23.08	53.37	30.30	150,535	27.69
26 January	22.10	56.25	34.15	147,442	27.85
2 February	22.59	56.51	33.92	145,847	27.99
9 February	22.64	55.71	33.07	136,649	28.10
16 February	22.58	55.98	33.40	136,951	28.21
23 February	21.97	54.77	32.80	151,558	28.31
2 March	22.61	53.52	30.91	141,516	28.36

Source: Agriculture Canada mimeograph, circulated weekly to various departments.

CHAPTER III

LITERATURE REVIEW

Introduction

For over thirty years, debate has taken place in economic literature as to whether or not programs intended to aid the stabilization of incomes and/or prices are beneficial to consumers and to producers. This debate has used theoretical constructs as well as empirical studies. This chapter is intended as an overview of some of the relevant literature.

The Consumer and Producer Surplus Approach

In 1944, Frederic Waugh[1] showed that the consumer can benefit from price instability. In his analysis, Waugh demonstrated that when price instability resulted from unstable supplies, if prices were stabilized at their arithmetic mean, consumers suffered a loss in consumer surplus.[2] In Figure 1, a single commodity case, it can be seen that by stabilizing price at P_o, the arithmetic mean of P_1 and P_2, the consumer retains the consumer surplus area L but loses the area G. Since G is larger than L, the consumer is worse off

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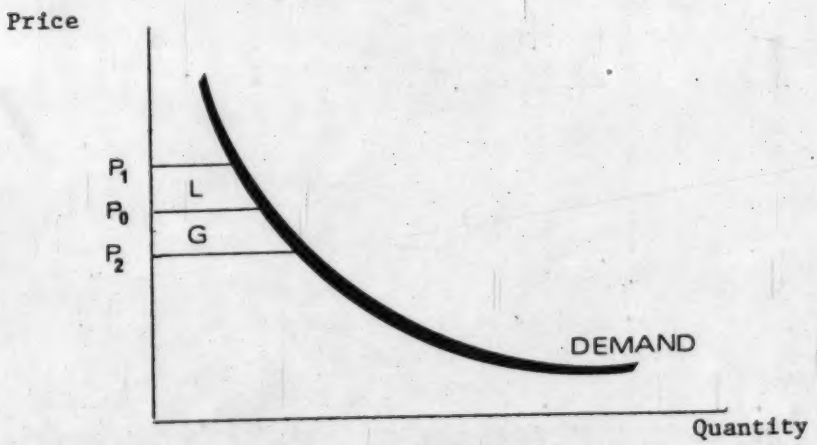
[1] F. V. Waugh, "Does the Consumer Benefit From Price Instability?", Quarterly Journal of Economics, LVIII, (August 1944), p. 602.

[2] Consumer surplus is that area below the demand curve and above the price line. It represents the gain to the consumer for not having to pay a higher price for a particular good. It should be noted that the assumption, the marginal utility of money is constant for all consumers of that good, must hold. For a good discussion on consumer surplus see: C. A. Tisdell, Microeconomics, The Theory of Economic Allocation, (Sidney: John Wiley and Sons Australasia Pty., Ltd.), 1972, p. 113.

with a stable price.[1]

Figure 3.1

ILLUSTRATION OF DECLINE OF CONSUMER SURPLUS



Waugh's analysis drew criticism from Howell[2] and Lovasy.[3] Howell criticized Waugh for using an arithmetic mean at which to stabilize prices. Howell showed that a price stabilized at a weighted mean could increase the consumer surplus. Lovasy argued that in the multi-commodity case, only if prices all move in the same direction at the same time, will consumers be better off with freely fluctuating prices. Since fluctuating prices of one good may affect the prices of other goods, Lovasy concluded that stabilization at a

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[1] This is a probability argument in that the consumer does not really gain the area L but the possibility of P_2 existing has been done away with, so the consumer can never have a consumer surplus of area L and G and thereby "loses" some consumer surplus.

[2] L. D. Howell, "Does the Consumer Benefit from Price Instability?" Quarterly Journal of Economics, LIX (February 1945), p. 287.

[3] G. Lovasy, "Further Comment", Quarterly Journal of Economics, LIX (February 1945), p. 296.

weighted mean can be beneficial to the consumer.

In 1961, Walter Oi[1] concluded that producers could be better off with fluctuating prices which resulted from fluctuations in demand than they could be with a price which was the arithmetic mean of the variable prices. Similar to Waugh, Oi used the tool of producer surplus to show that the area comprising the producers' surplus after stabilization was less than before stabilization occurred at the arithmetic mean.[2]

Oi's work drew criticism from Tisdell.[3] Tisdell argued that a situation of complete uncertainty will not necessarily lead to greater average profit. Tisdell based his argument on the fact that supply adjustments must be instantaneous if Oi's thesis is to hold. Since this is not true in reality, producers must be able to forecast prices correctly, which is also not possible. This leads to the conclusion that price stability will bring greater average profit.

In 1969, Benton Massell[4] integrated the Waugh-Oi analyses, and showed that a costless buffer stock program could provide a net

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[1] Walter Y. Oi, "The Desirability of Price Instability under Perfect Competition," Econometrica, XXIX (January 1961), p. 58.

[2] Producers' surplus is analagous to consumers' surplus but refers to the area above the supply curve and below the price line. Producer surplus takes into account a benefit producers may acquire by being able to sell their good at a price above the price at which they may have had to sell. In addition, the assumption that the marginal utility of money to producers is equal for all, must hold.

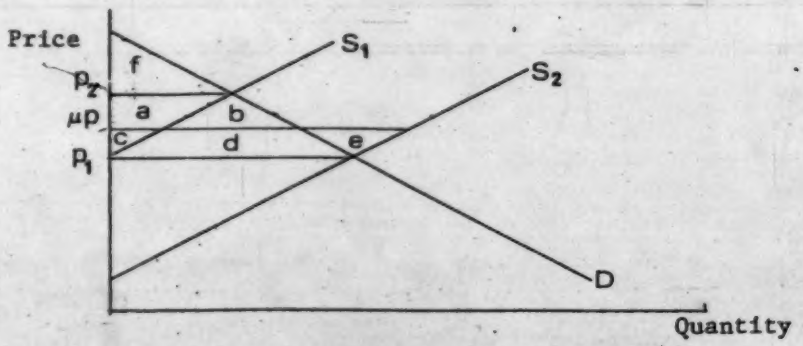
[3] Clem Tisdell, "Uncertainty, Instability, Expected Profit," Econometrica, XXXI (January - April 1963), p.243

[4] Benton F. Massell, "Price Stabilization and Welfare," Quarterly Journal of Economics, LXXXIII (May 1969), p. 284.

gain to consumers and producers. Massell first assumed that all price fluctuations resulted from supply shifts. Then, using the notion of expected values of consumer and producer surplus, he showed that producers could be sufficiently better off with price stabilization so as to compensate the consumers to offset their loss of consumer surplus. Referring to Figure 3.2, it can be seen that by raising price from P_1 to μP, the producer gains producer surplus to the extent indicated by the areas c + d + e, while the consumer loses consumer surplus to the extent of area c+d. Then by reducing the price from P_2 to μP, the consumer gains consumer surplus to the extent indicated by areas a + b, while the producer loses producer surplus to the extent indicated by area a. The result is a net gain of consumer surplus to the extent indicated by area b and a net gain of producer surplus to the extent indicated by the area e. Thus it can be seen that there is a total gain indicated by areas b + e if price is stabilized at the arithmetic mean. A similar sort of analysis can be followed through for shifts in the demand curve.

Figure 3.2

MASSELL'S EXPECTED CONSUMER-PRODUCER SURPLUS APPROACH



In 1972, Hueth and Schmitz[1] extended the Waugh - Oi and Massell analyses to an international context. Using consumer and producer surplus analysis, Hueth and Schmitz concluded that the source of the instability, ie., demand or supply shifts, will determine whether or not instability is desirable. They also point out that compensation is usually never paid by those who gain from stability and, therefore, determining if there is a welfare gain or loss is difficult.

In 1974, Turnovsky[2] considered the "gains" from price stabilization in the case where demand and supply decisions are made before the actual price is known. Thus price expectations are based on "adaptive" or "rational" schemes.[3] This extension of the Waugh - Oi - Massell studies led to conclusions that if price expectations are formed rationally, the Oi result will hold, provided the demand fluctuations are positively or negatively autocorrelated. If the price expectations are formed adaptively, however, the Oi result will not hold true, ie., stabilization increases welfare. The Waugh result--that consumer surplus will be reduced by price stabilization if the cause of the instability is stochastic supply fluctuations--was shown to be true

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[1] D. Hueth and A. Schmitz, "International Trade in Intermediate and Final Goods: Some Welfare Implications of Destabilized Prices," Quarterly Journal of Economics, LXXXVI (August 1973), p. 351.

[2] S. J. Turnovsky, "Price Expectations and the Welfare Gain From Price Stabilization," American Journal of Agricultural Economics, Vol. 56, No. 4 (November 1974), pp. 706-716.

[3] Supply decisions based on "Adaptive Behavior" means producers look to their past price forecasts and adapt their forecasts by the amount of past error. "Rational" supply decisions, however, take into account not only past error of prediction, but also information from the surrounding economic system. That is, the forecasters, producers, aware of the economic system, form their price expectations from predictions of the model.

in cases where price expectations are formed rationally or adaptively. Massell's result--that price stabilization provides a net gain to producers and consumers--was shown to hold true in cases where price expectations were formed rationally or adaptively.

Stabilization Programs

The initial portion of this chapter surveyed some literature concerned with the theoretical debate regarding the desirability of price stabilization. The following portion of this chapter will deal with literature concerned with actual stabilization programs and their applicability.

Theoretical Approach

In 1952, Bauer and Paish[1] wrote an article generally considered to be a classic in its field. Bauer and Paish surveyed various stabilization schemes-- schemes to maintain producers' prices and incomes (such as tariff protection, quotas, subsidies, buffer stock schemes) and restriction schemes. In most cases the schemes did not fulfill the following characteristics of a stabilization scheme. These characteristics are:

1) the scheme should specify removal of fluctuations around the trend over a relevant time period;
2) the scheme should smooth income variations resulting from fluctuating crop volume;
3) the policy objectives should be clearly defined, (eg. is the objective to force saving for development or raise producer income by restricting output?);
4) the scheme should have embodied in it devices to guard against any movement away from the trend;
5) a scheme should be able to predict cash flow a short

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[1] P. T. Bauer and F. W. Paish, "The Reduction of Fluctuations in the Incomes of Primary Producers," Economic Journal, LXII (December 1952), p. 750.

distance into the future.[1]

Bauer and Paish put forward a weighted moving average formula which fulfilled the above criteria and upon which crop payments would be based.[2] They argued that their formula would act as an automatic scheme; that is, the formula would determine payments to producers and those administering the scheme would not need to make any of the decisions, thus avoiding political pressures when setting producer prices.[3]

The Bauer and Paish article was criticized by a number of people including Friedman.[4] Friedman argued that strict use of the Bauer and Paish formula would impinge upon the freedom of producers. He also argued that the Bauer and Paish formula would stabilize cash receipts but not net income since costs of inputs would be left to

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[1] IBID., PP. 766 - 767

[2] See Appendix A.

[3] In a complimentary article: Wilfred Candler and Alastair McArthur, "Efficient Equalization Funds for Farm Prices," Journal of Farm Economics, Vol 50, No. 1, p. 91, outlined a mathematical function for paying out equalization payments. They tried to determine the size of the fund which would be necessary to most reduce the variance of prices. That is, during a time of boom they would try to find how much the buffer fund should accumulate before receipts should be paid out to the producer.

[4] Milton Friedman, "The Reduction of Fluctuations in the Income of Primary Producers: A Critical Comment," Economic Journal, LXIV (December 1954), p. 698. Others criticizing Bauer and Paish were: Polly Hill, "Fluctuations in Incomesof Primary Producers," Economic Journal, LXIII (June 1953); P. Ady, "Fluctuations in Incomes of Primary Producers: A Comment," Economic Journal, LXIII (September 1953); and B.M. Niculescu, "Fluctuations in Incomes of Primary Producers: Further Comment," Economic Journal, LXIV (December 1954), p. 730.

fluctuate freely as dictated by the market. Thus the formula could have deleterious affects on the long-run position and incentive of the producer.

In 1963, Snape and Yamey[1] looked at the effects of a buffer fund program in a number of different instances. They assumed one exporting agency which sets the price which producers must take. They also assumed no supply reaction if the price set by the agency differed from the actual export price. Finally, they assumed no difference between export and domestic prices except for transportation and marketing costs. Based on these assumptions, Snape and Yamey traced the effects of a number of different demand and supply schedules. Then a buffer fund program was hypothesized and the effects on export and producer receipts were noted. They concluded that, depending on the different demand and supply schedules, the buffer fund may or may not increase total producer receipts.[2]

In 1964, Campbell[3] criticized commodity stabilization programs. He felt that many stabilization programs were merely price or

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[1] R.H. Snape and B.S. Yamey, "A Diagrammatic Analysis of Some Effects of Buffer Fund Stabilization," Oxford Economic Papers: New Series, XV, (June 1963), p. 95.

[2] There was a similar article written in 1964: Richard C. Porter, "The Optimal Price Problem in Buffer Fund Stabilization," Oxford Economic Papers, New Series, XVI (November 1964), p. 423. This analysis assumed no consumption domestically for that particular product although Porter did incorporate some of Snape and Yamey's assumptions into his analysis. He concludes that a buffer fund will induce greater export price instability.

[3] Keith O. Campbell, "National Commodity Stabilization Programs: Some Reflections Based on Australian Experience," International Explorations of Agricultural Economics, ed. by R.E. Dixey (Ames: Iowa State University Press, 1964), p. 55.

income support mechanisms. Such programs lead to non-optimal resource allocation, adverse effects on disposable income and, consequently, non-optimal investment. Campbell advocated an aggregate fiscal or monetary policy for the whole economy in a developed country.

In 1967, McKinnon[1] advocated the use of futures markets as a stabilization tool. He argued that if a government or government agency set or guaranteed a futures price in a distant period, producers could hedge production against demand fluctuations thereby stabilizing their gross income. Then, by using a buffer stock to mitigate against supply fluctuations, the producer could guarantee a stable gross income. It is necessary to note that McKinnon's argument holds only for storable commodities.

In 1969, Tomek[2] wrote a comprehensive and useful paper on the topic of stability for primary products. He briefly surveyed various papers concerning stabilization as well as various stabilization measures such as buffer stocks, buffer funds, and futures prices. He also discussed the various benefits and costs such measures might have on producers and consumers and summarized the problems inherent in each stabilization scheme. This is a useful compendium of many of the diverse issues found in the literature.

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[1] Ronald I. McKinnon, "Futures Markets, Buffer Stocks and Income Stability for Primary Producers," Journal of Political Economy, LXXV (1967), p. 844.

[2] William G. Tomek, Stability for Primary Products: Means to What Ends? Occasional Paper No. 24, USDA Prices Research Project. (Ithaca:Cornell University, Department of Agricultural Economics, September 1969).

Empirical Studies

In 1959, Gislason[1] wrote about the operations of the Canadian Wheat Board. He argued that the Canadian Wheat Board had decreased net revenues which would have accrued to farmers had they been allowed to sell their wheat to private agencies. The basis of his argument was that speculative losses by the Canadian Wheat Board had been substantial. Speculative loss as defined by Gislason is the average change in wheat price from one year to the next plus the cost of storage multiplied by the quantity stored. He argued that there were no offsetting benefits to the farmer which could be clearly ascertained and, therefore, it followed that producers would have been better off had they sold to private agencies which would have realized the speculative gains to be made. Gislason, however, did not take into account any of the benefits, such as increased transportation efficiency, increased equity in delivery opportunities, or the possibility of the Canadian Wheat Board's selling price exceeding those of private traders because of its stronger market position, which did accrue to Canadian producers.

In 1960, Powell[2] attempted to ascertain the actual effect that supply instability had on price instability with respect to Australian wool. Powell developed an index (c) which was the ratio of the "supply effect" over the "total effect". The "supply effect" was found by as-

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[1] Conrad Gislason, "How Much has the Canadian Wheat Board Cost Canadian Farmers," Journal of Farm Economics, XXXXI (August 1959), p. 584.

[2] Alan Powell, "Production and Income Uncertainty in the Wool Industry: An Aggregate Approach," Australian Journal of Agricultural Economics, IV (July 1960), p.88

suming demand to be stable. Then, each level of output should have a corresponding price which results from the demand and supply interaction. This theoretical price times quantity gives the "supply effect". The "total effect" is taken to be the actual annual observed income variability. By comparing this index ("supply effect" divided by "total effect") with a number of likely levels of demand elasticity, Powell was able to point out that for wool, reducing production instability to zero led to a maximum increase in income stability of about 11 percent or less.

In 1963, Powell and Campbell[1] tried to determine the effect that changes in elasticity of demand could have on a buffer stock program for wool. They showed that in the operation of a buffer stock scheme any net returns which accrue because of changes in the elasticity of demand are made up of speculative plus non-speculative returns as well as some non-visable effects. Based on the assumptions that there were constant elasticity demand curves and that the authority responsible for maintaining a floor price succeeded in maintaining it at a specified level, Powell and Campbell were able to compute a matrix of possible hidden gains and losses. The results showed "hidden" losses from 14.9 million Australian dollars to gains of 11.8 million Australian dollars when the authority was able to accumulate 5 percent of the total clip in order to maintain the floor price. In the case where the authority could purchase 10 percent of the total clip, the range of values was larger.

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[1] Alan Powell and Keith O. Campbell, "The Significance of Non-Speculative Returns in the Appraisal of Buffer Stock Schemes," Journal of Farm Economics, XXXXIV (August 1962), p. 876.

In 1964, Gruen[1] extended the work done by Powell and Campbell. Dealing with the question of the effect which a reserve stock scheme may have on the substitution of other fibres for wool and using essentially the same method as Powell and Campbell, Gruen showed that the "hidden" gains or losses inherent in a buffer stock scheme do not influence the general tendency to move from wool to other fibres.

In 1973, Chapman and Foley[2] analyzed the wool processing industry in Australia. They argued that costs of wool to the processors could rise with price stabilization bringing about a loss in producer surplus. This results from the fact that if fluctuations in price are caused by demand shifts, then stabilizing price at the mean will increase the variability of supply to the wool processor resulting in increased costs if his marginal cost curve slopes upward and to the right. Chapman and Foley provided a framework which showed the importance of demand elasticity in determining if price stabilization will or will not provide a net gain to society.

In 1973, Houck[3] argued for stability on welfare and resource allocation grounds. He points out that stabilization measures can work outside the market in the manner of a progressive income tax or

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1 F.H. Gruen, "Some Hidden Gains and Losses of a Wool Reserve Scheme" Australian Journal of Agricultural Economics, VIII, No.2 (December 1964), p. 181.

2 R. Chapman and K. Foley, "A Note on Losses from Price Stabilization," Australian Journal of Agricultural Economics, XVII, No.2 (August 1973), p. 140.

3 James P. Houck, "Some Aspects of Income Stabilization for Primary Producers," Australian Journal of Agricultural Economics, XVII, No.3 (December 1973), p. 200

within the market as does a buffer stock program. Houck showed that price and income stability can be jointly achieved when demand shifts are larger relative to supply shifts and/or demand is relatively inelastic at the producer level. Houck also was able to divide income variability into its component parts - - that part directly attributable to price variability, that part attributable to supply variability and that part representing a linear interaction term for price and quantity. He followed this procedure in analysing wool, wheat and beef. Houck's method is used Chapter IV of this study. His analysis is valuable because through recognition of the major source of instability in gross income, be it price or quantity, policymakers can then design a program best suited to that commodity.

In 1974, Girão, Tomek and Mount[1] tried to ascertain whether income stability would help farmers make better investment and consumption decisions. Utilizing five consumption functions, two investment functions and data from fifty Southern Minnesota farms, regression analysis was done to determine how income variability affected various variables such as fixed investment and farm machinery and equipment.[2] They concluded that farm investment is influenced by instability and that investment is less responsive to savings and to changes in sales for farmers with unstable incomes than for those with stable incomes. They also concluded that the investment decisions of farmers with less

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[1] J. A. Girão, W. G. Tomek and T. D. Mount, "The Effect of Income Instability on Farmers' Consumption and Investment," The Review of Economics and Statistics, LVI, No. 2 (May 1974), p. 141.

[2] This analysis divides the cross-section data into high and low income variability groups to separate out the effects of investment and consumption in their regression analysis.

stable incomes are shorter run in character.

Obviously, the debate on the relative merits of price, income and supply stabilization has been wide ranging and not entirely conclusive. In the following Chapter, however, an attempt will be made to utilize Houck's analysis to ascertain the principal source of income variability for hogs in Canada.

CHAPTER IV

THE DEGREE AND SOURCE OF INCOME INSTABILITY

Introduction

In Chapter III it was noted that economists are far from agreeing on whether income and/or price stabilization is of merit. There have been a number of different methods for price, income and supply stabilization analysis suggested over time. From a practical point of view, it would seem that Houck's method of ascertaining the relative contribution of price and supply variability to total revenue variability, is a worth-while point to pursue further in the Canadian context. Therefore this chapter seeks to examine income instability in wheat and barley, hogs, cattle and calves for Canada, Alberta, Eastern Canada and Western Canada. The extent of income instability for the period is then apportioned into its price and output (marketings) components.

The Degree of Variability in Farm Cash Receipts

In Chapter II reference was made to the Agricultural Stabilization Board in Canada.[1] A description of the Board's powers and some of its activities were noted. However, two very fundamental questions remain to be answered. What has the degree of agricultural income instability been and has the Agricultural Stabilization Board been successful in reducing the degree of income instability?

Empirical investigation was undertaken for the years 1960 to 1974 inclusive, in an attempt to determine if the Board had in fact been effective in stabilizing aggregate gross farm income to producers. This was done by analyzing farm cash receipts with and without Board payments

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[1] Chapter II, p. 13.

to producers. Using a trend corrected coefficient of variation and, for comparative purposes, Coppock's instability index,[1] one can estimate the percentage variability for both total farm cash receipts from farming operations in Canada and total farm cash receipts from farming operations minus agricultural stabilization payments.

Table 4.1

AGGREGATE FARM CASH RECEIPTS INSTABILITY WITH AND WITHOUT AGRICULTURAL STABILIZATION PAYMENTS, CANADA, 1960 TO 1974

	Trend Corrected Coefficient of Variation	Instability Index
	%	%
Total Cash Receipts from farming operations	16.28	8.13
Total Cash Receipts from farming operations minus agricultural stabilization payments	16.17	7.90

Note: Farm Cash Receipts and Agricultural Stabilization Program Payments were taken from: Statistics Canada, Farm Cash Receipts, Catalogue 21-001 (Ottawa: Information Canada, various years). The agricultural stabilization payments which were subtracted were dairy supplementary payments, deficiency payments, and supplementary payments. On occasion, deficiency payments made could not be separated from the farm cash receipts for the commodity in question. In addition, this analysis masks the effects of stabilization payments on individual commodities and thus the analysis is somewhat limited.

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[1] The formula for a trend corrected coefficient of variation is: $\sqrt{\frac{\sum_{i=1}^{n} (\hat{Y} - Y_i)^2}{n}} \Big/ \bar{Y}$

where: $\hat{Y}$ is the estimated trend,
Y_i is the actual observation, and
$\bar{Y}$ is the mean of the variable.

The instability index is used extensively by Coppock in his book: Joseph D. Coppock, International Economic Instability. The experience after World War II (New York, McGraw-Hill Book Company Inc., 1962). Coppock's formula is:

$$Vlog = \sum \left(\frac{\log Y_{t+1} - \log Y_t}{N} - M \right)$$

$$\text{Instability Index} = \text{antilog} \sqrt{Vlog}$$

Table 4.1 suggests that efforts to stabilize aggregate gross income from agricultural products have not shown significant results. However, the foregoing is a very cursory analysis and a much more detailed analysis is necessary before any firm conclusions can be drawn. In this regard a more detailed analysis is undertaken on the commodities mentioned earlier. The following section is a brief description of the method which was used in apportioning income, or total revenue as a proxy for income, into its component parts.

Apportioning Statistical Variances of Identities into their Component Parts and Empirical Results

Since most stabilization programs are intended to decrease the variability in producers' incomes, it is helpful to know which of the components, price or quantity, is the greatest contributor to income variability. Using the approach of Burt and Finley,[1] which was also used by Houck,[2] one can approximately estimate the percentage variation in income caused by changing prices and/or changing quantities. This approach also measures the linear interaction between the two components.

Burt and Finley showed that given an identity:

$$Y = X_1 X_2 \qquad (1)$$

where: Y may be assumed to be income,

X_1 is price, and

X_2 is quantity,

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[1] Oscar R. Burt and Robert M. Finley, "Statistical Analysis of Identities in Random Variables" American Journal of Agricultural Economics, L, No. 3 (1968), pp. 734-744

[2] James P. Houck, "Some Aspects of Income Stabilization for Primary Producers" Australian Journal of Agricultural Economics, XVII, No. 3 December (1973), pp. 200-215

the variability of income can be estimated by:

$$\text{Var}\ (Y) = U_2^2\ \text{Var}\ (X_1) + U_1^2\ \text{Var}\ (X_2) + 2U_1\ U_2\ \text{Cov}\ (X_1\ X_2) + E\left[(X_1 - U_1)\ (X_2 - U_2) - \text{Cov}\ (X_1\ X_2)\right]^2 + 2U_1\ E(X_1 - U_1)\ (X_2 - U_2)^2 + 2U_2\ E\ (X_1 - U_1)^2\ (X_2 - U_2) \quad (2)$$

where:

U_2 is the mean of the variable X_2,

U_1 is the mean of the variable X_1, and

$\text{Cov}(X_1\ X_2)$ is the covariance of X_1 and X_2.

Since the last three terms in equation (2) can be dropped,[1] as they have little effect on the left-hand term, then equation (2) can be rewritten as follows:

$$\text{Var}(Y) \simeq A + B + C \quad (3)$$

where:

$A = U_2^2\ \text{Var}\ (X_1)$,

$B = U_1^2\ \text{Var}\ (X_2)$,

$C = 2U_1\ U_2\ \text{Cov}\ (X_1\ X_2)$.

To convert the relative contributions of each component contributing to income variability into percentage terms, the following simple format is used:

$$P_1 = \frac{A}{A + B} \quad (4)$$

$$P_2 = \frac{B}{A + B} \quad (5)$$

$$P_3 = \frac{C}{A + B} \quad (6)$$

where:

P_1 is the percentage contribution of price variability to

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[1] For discussion on this point, see Burt and Finley as well as Arthur S. Goldberger, "On the Statistical Analysis of Identities: Comment," American Journal of Agricultural Economics, LII, No. 1 (1970), pp. 154-155.

income variability,

P_2 is the percentage contribution of quantity variability to income variability, and

P_3 is the percentage of income variability caused by the linear interaction of price and quantity variability.

The variables A, B, and C were defined in Equation (3).

Using this approach,an attempt was made to apportion the income variability for hog producers into its relative component parts. For comparative purposes the same procedure was followed for wheat, barley and cattle and calves.

For hogs and cattle and calves the annual data used were collected for Alberta, Western Canada, Eastern Canada, and Canada as a whole in order to observe any regional differences. The same procedure was not followed for wheat and barley since almost all of these grains are grown on the prairies and a comparison of Eastern and Western Canada was of much less significance. The first step was to estimate the degree of variability for price, quantity and income for each commodity over a period of twenty-four years, 1950 to 1973.

Variability in Income, Price and Quantity for Hogs

Tables 4.2, 4.3 and 4.4 show the estimated degree of variability for annual aggregate farm cash receipts, for slaughterings and for value per head for hogs in the various regions under study . Farm cash receipts were used as a proxy for income, slaughterings as a proxy for quantity and value per head as a proxy for price. The proxies were necessary due to the fact that the identity relationship had to be maintained (ie. $Y = P \times Q$) and income data were not available while farm cash receipts data were. Thus, to maintain the iden-

tity, farm cash receipts was divided by slaughterings to equal value per head. However, it does not necessarily hold true that price times slaughterings equals farm cash receipts. The same procedure was followed for wheat, barley and cattle and calves.

Tables 4.2 and 4.3 illustrate that the coefficient of variation was invariably larger than either the coefficient of variation corrected for trend or the instability index. This indicated that there had been a fairly noticeable trend in farm cash receipts and for hog slaughterings. Table 4.4 does not indicate a definite trend in hog value per head over the years. In fact, for all regions the instability index is larger than the coefficient of variation for hog value per head, possibly indicating that no definite discernable linear trend has existed over time.

Table 4.2

PERCENTAGE DEGREE OF VARIABILITY OF ANNUAL AGGREGATE FARM CASH RECEIPTS FOR HOGS, VARIOUS REGIONS, 1950-1973

	Canada	Alberta	Eastern Canada	Western Canada
	%	%	%	%
Coefficient of Variation	32.26	28.10	27.25	42.77
Coefficient of Variation Corrected for Trend	23.02	20.46	20.98	29.19
Instability Index	14.71	15.60	15.53	16.22

The degree of variability of farm cash receipts has generally been greater than the degree of variability of hog slaughterings and hog value per head. For example, the coefficient of variation corrected for

trend (hereinafter referred to as C.V.C.T.) was estimated to be 23.02 percent for farm cash receipts in Canada whereas the C.V.C.T. for hog slaughterings and hog value per head in Canada was only 11.99 percent and 20.78 percent, respectively.

Table 4.3

PERCENTAGE DEGREE OF VARIABILITY OF HOG SLAUGHTERINGS IN FEDERALLY INSPECTED ESTABLISHMENTS, VARIOUS REGIONS, 1950-1973

	Canada	Alberta	Eastern Canada	Western Canada
	%	%	%	%
Coefficient of Variation	23.20	25.10	22.30	27.72
Coefficient of Variation Corrected for Trend	11.99	14.22	11.26	17.88
Instability Index	16.36	17.92	17.30	20.80

Table 4.4

PERCENTAGE DEGREE OF VARIABILITY OF HOGS, VALUE PER HEAD FOR VARIOUS REGIONS, 1950-1973

	Canada	Alberta	Eastern Canada	Western Canada
	%	%	%	%
Coefficient of Variation	21.23	23.64	20.40	23.93
Coefficient of Variation Corrected for Trend	20.78	22.25	19.26	22.71
Instability Index	22.94	25.24	23.00	24.45

In general, the degree of variability of farm cash receipts, hog slaughterings and hog value per head was greater in Western Canada

than in Eastern Canada. For example, the C.V.C.T. for farm cash receipts in Eastern Canada was estimated to be 20.98 percent, while the C.V.C.T. for farm cash receipts in Western Canada was estimated to be 29.19 percent, indicating greater variability of gross income to hog producers in Western Canada than in Eastern Canada. In addition, the C.V.C.T. for hog slaughter was estimated to be 11.26 percent in Eastern Canada and 17.88 percent in Western Canada, while the C.V.C.T. for hog value per head was estimated to be 19.26 percent in Eastern Canada and 22.71 percent in Western Canada.

Variability in Income, Price, and Quantity for Cattle and Calves

For comparative purposes, exactly the same procedure as that used for hogs was used for estimating the degree of annual variability of farm cash receipts, slaughterings and value per head for cattle and calves. Tables 4.5, 4.6 and 4.7 illustrate the estimations of the percentage variability of farm cash receipts (Table 4.5), cattle and calves slaughterings (Table 4.6), and average annual value per head for cattle and calves combined (Table 4.7) for the study regions.

In all cases ,the coefficient of variation was estimated to be greater than both the coefficient of variation corrected for trend and the instability index calculated for all the regions under study. This indicates that there has been a noticeable trend over time for farm cash receipts, slaughterings and value per head, in all regions in Canada. This result contrasted with the result obtained for hog value per head. For example, the coefficient of variation for hog value per head was estimated to be 21.23 percent for Canada, 23.64 percent for

Alberta, 20.40 percent for Eastern Canada, and 23.93 percent for Western Canada while the instability index, which was a trend corrected measure, for hog value per head was 22.94 percent, 25.24 percent, 23 percent, and 24.45 percent, respectively. The same situation did not hold true for cattle and calves. For example, the coefficient of variation for cattle and calves value per head was estimated to be 30.37 percent in Canada, 23.37 percent in Alberta, 31.48 percent for Eastern Canada, and 28.22 percent for Western Canada, while the instability index was estimated to be 15.5 percent, 19.49 percent, 15.05 percent and 18.24 percent, respectively.

Table 4.5

PERCENTAGE DEGREE OF VARIABILITY OF ANNUAL AGGREGATE FARM CASH RECEIPTS FOR CATTLE AND CALVES, VARIOUS REGIONS, 1950-1973

	Canada	Alberta	Eastern Canada	Western Canada
	%	%	%	%
Coefficient of Variation	42.32	52.62	35.21	49.03
Coefficient of Variation Corrected for Trend	15.59	19.35	12.23	19.51
Instability Index	12.79	15.51	12.30	15.44

There were a number of interesting comparisons of the estimated results for hogs and cattle and calves. First, farm cash receipts for cattle and calves were estimated to have had a lower degree of variability than farm cash receipts for hogs. The C.V.C.T. for hogs was estimated to be 23.02 percent, 20.46 percent, 20.98 percent and 29.19 percent for Canada, Alberta, Eastern Canada and Western Canada respectively, while

for the same regions, the C.V.C.T. for farm cash receipts for cattle and calves were estimated to be 15.59 percent, 19.35 percent 12.23 percent and 19.51 percent respectively. Secondly, the same pattern held true for the comparison between hog and cattle and calves slaughterings at federally inspected establishments. In all cases the C.V.C.T.'s estimated for hog slaughterings were greater than the C.V.C.T.'s estimated for cattle and calves slaughterings.

Table 4.6

PERCENTAGE DEGREE OF VARIABILITY OF CATTLE AND CALF SLAUGHTER IN FEDERALLY INSPECTED ESTABLISHMENTS, VARIOUS REGIONS, 1950-1973

	Canada	Alberta	Eastern Canada	Western Canada
	%	%	%	%
Coefficient of Variation	18.71	46.15	13.93	26.33
Coefficient of Variation Corrected for Trend	8.94	7.35	10.62	8.39
Instability Index	8.46	9.70	8.57	10.06

Table 4.7

PERCENTAGE DEGREE OF VARIABILITY OF CATTLE AND CALVES VALUE PER HEAD, VARIOUS REGIONS, 1950-1973

	Canada	Alberta	Eastern Canada	Western Canada
	%	%	%	%
Coefficient of Variation	30.37	23.37	31.48	28.22
Coefficient of Variation Corrected for Trend	19.86	22.71	19.65	20.79
Instability Index	15.50	19.49	15.05	18.24

The same could not be said about value per head, however. The C.V.C.T. for hog value per head was estimated to be 22.25 percent in Alberta while the C.V.C.T. for cattle and calves in Alberta was estimated to be 22.71 percent for the same time period. The same held true for value per head in Eastern Canada as the C.V.C.T. was estimated to be slightly lower for hogs than for cattle and calves. Since this comparison between hogs and cattle and calves is a preliminary one, no tentative conclusions as to the relative contributions of price and quantity to gross income variability will be drawn. First, the variability of farm cash receipts, marketings and average value per bushel for wheat and barley in Canada were estimated.

Variability in Income, Price and Quantity for Wheat and Barley

As stated previously, the variability of wheat and barley farm cash receipts, marketings and average value per bushel was estimated only for one region, Canada. Tables, 4.8 and 4.9 show the estimmated degree of variability for wheat and barley for 1950 to 1973 in Canada.

The estimated degree of variability of farm cash receipts for barley in Canada was much greater than the estimated degree of variability of farm cash receipts for hogs (ie., estimated C.V.C.T. for farm cash receipts of barley was 42.8 percent and only 23.02 percent for hogs). The same held true when barley was compared with cattle and calves (ie., the estimated C.V.C.T. for farm cash receipts for barley was 42.8 percent and only 15.59 percent for cattle and calves). The estimated degree of variability of farm cash receipts for wheat in Canada, on the other hand, was only 25.94 percent, close to the estimated degree of varia-

bility of farm cash receipts for hogs.

Table 4.8

PERCENTAGE DEGREE OF VARIABILITY OF ANNUAL AGGREGATE FARM CASH RECEIPTS, MARKETINGS, AND AVERAGE VALUE PER BUSHEL FOR BARLEY IN CANADA, 1950-1973

	Farm Cash Receipts	Marketings	Average Value/Bu.
	%	%	%
Coefficient of Variation	51.47	48.85	23.80
Coefficient of Variation Corrected for Trend	42.80	41.90	23.12
Instability Index	29.18	33.09	31.50

Table 4.9

PERCENTAGE DEGREE OF VARIABILITY OF ANNUAL AGGREGATE FARM CASH RECEIPTS, MARKETINGS AND AVERAGE VALUE PER BUSHEL FOR WHEAT IN CANADA, 1950-1973

	Farm Cash Receipts	Marketings	Average Value/Bu.
	%	%	%
Coefficient of Variation	33.22	22.19	19.20
Coefficient of Variation Corrected for Trend	25.94	18.65	16.73
Instability Index	29.08	20.38	24.67

The estimated degree of variability of barley marketings for Canada was higher than the estimated degrees of variability of hog and cattle and calf slaughterings (ie., the estimated C.V.C.T. for barley marketings was 41.9 percent compared to the estimated C.V.C.T.

for hog slaughterings, 11.99 percent, and the estimated C.V.C.T. for cattle and calf slaughterings, 8.94 percent.) The degree of estimated variability of wheat marketings was 18.65 percent and was much closer to the estimated degrees of variability found in hog and cattle and calf slaughtering.

The estimated degree of variability of barley average value per bushel was 23.12 percent as indicated by the C.V.C.T., while the estimated degree of variability of wheat average value per bushel was 16.73 percent as indicated by the C.V.C.T. In comparison, the estimated C.V.C.T. for hog value per head was 20.78 percent and the estimated C.V.C.T. for cattle and calves value per head was 19.86 percent. Generally, then, the estimated degree of variability was highest for barley in Canada with wheat having the second highest estimated degree of variability for farm cash receipts, average value and marketings. As mentioned previously, the analysis of the variability of hogs and cattle and calves showed cattle to be less variable in farm cash receipts and slaughterings than hogs. Nothing conclusive could be stated about the estimated variability of the value per head for cattle and calves and hogs, except that a comparison among the estimated variability measures provided mixed results.

While this section gives an indication of which components of gross income contributed the larger amount of variability to gross income (farm cash receipts), a somewhat more refined analysis was necessary to provide more conclusive evidence as to whether price or quantity caused most of the variability. The immediately following section provides a description of the results of the analysis of apportioning the degree of variability of gross income into the relative contribution

of its component parts, price and quantity.

The Empirical Results of The Apportionment of Gross Income Variability

Tables 4.10, 4.11 and 4.12 are provided as a summary of the results of the analysis which attempted to apportion income variability into its' component parts. Table 4.10 illustrates the results for the analysis of hogs for Canada, Alberta, Eastern Canada and Western Canada. Table 4.11 illustrates a similar set of estimated results for cattle and calves in the same regions while Table 4.12 illustrates the results of the analysis of wheat and barley for Canada.

Table 4.10

DEGREE OF HOG PRODUCERS' FARM CASH RECEIPTS VARIABILITY CAUSED BY AVERAGE VALUE PER HEAD (PRICE) VARIABILITY AND SLAUGHTERING (QUANTITY) VARIABILITY FOR VARIOUS REGIONS IN CANADA, 1950-1973

Amount of Income Variation Attributable to:		Canada	Alberta	Eastern Canada	Western Canada
		%	%	%	%
Price	$\frac{A}{A+B}$	75.01	71.00	74.54	61.73
Quantity	$\frac{B}{A+B}$	24.99	29.00	25.45	38.27
Linear Interaction	$\frac{C}{A+B}$	22.71	47.20	20.58	26.09

It was estimated that most gross annual income variability for hogs was caused by price (or average value per head) variability. This result was true for all regions. For example, it was estimated that price variability caused 75.01 percent of the variability of annual gross income in Canada and 71 percent of the variability in Alberta. Quantity

variability was estimated to have contributed 24.99 percent of gross annual income variability in Canada and 29.0 percent in Alberta. The linear interaction term (eg., 22.71 percent for Canada) suggested that price and quantity variability interaction provided some degree of income variability. That is, the interaction of price and quantity contributed to income variability.

Table 4.11

DEGREE OF CATTLE AND CALF PRODUCERS' FARM CASH RECEIPTS VARIABILITY CAUSED BY AVERAGE VALUE PER HEAD (PRICE) VARIABILITY AND SLAUGHTERING (QUANTITY) VARIABILITY FOR VARIOUS REGIONS IN CANADA, 1950-1973

Amount of Income Variation Attributable to:		Canada	Alberta	Eastern Canada	Western Canada
		%	%	%	%
Price	$\frac{A}{A+B}$	83.16	90.52	77.39	85.98
Quantity	$\frac{B}{A+B}$	16.84	9.48	22.61	14.02
Linear Interaction	$\frac{C}{A+B}$	50.79	6.14	65.13	30.71

A similar analysis was undertaken for cattle and calves. It was estimated that price variability contributed at least 90.52 percent of the variability of annual gross income and the estimated contribution of quantity variability was estimated to be as low as 9.48 percent in Alberta. The high linear interaction terms for Canada (50.79 percent) and Eastern Canada (65.13 percent) showed that the interaction of price and quantity contributed significantly to gross annual income variability. This suggested that price and quantity variations tended to be more in the same direction at the same time in Eastern

Canada and Canada than in Alberta and Western Canada.

The estimated contribution of price variability for barley to gross annual income in Canada was only 23.35 percent compared to 83.16 percent for cattle and calves and 75.01 percent for hogs. The estimated contribution of price variability for wheat was 44.58 percent. For both wheat and barley the linear interaction term was fairly low (11.82 percent for wheat and 29.04 percent for barley).

Table 4.12

DEGREE OF FARM CASH RECEIPTS VARIABILITY CAUSED BY AVERAGE VALUE PER BUSHEL (PRICE) VARIABILITY AND MARKETING (QUANTITY) VARIABILITY FOR WHEAT AND BARLEY, CANADA, 1950-1973

Commodity	Amount of Income Variation Attributable to: Price $\frac{A}{A+B}$	Quantity $\frac{B}{A+B}$	Linear Interaction $\frac{C}{A+B}$
	%	%	%
Wheat	44.58	55.42	11.82
Barley	23.35	76.65	29.04

The results of the immediately foregoing analysis suggest that stabilization programs which stabilize price will be of greatest benefit to livestock producers while stabilization policies which stabilize quantity fluctuations(such as the Lift program) will be of greatest benefit to grain producers. However, the analysis was based on annual data from 1950 to 1973, whereas most stabilization programs have usually been short-run in nature; ie.,lasting only one year or less. Therefore short-run, week-to-week fluctuations were analyzed for hogs and cattle to find if the results and the implications of the long-

run analysis would be borne out and reinforced by the short-run analysis.

Weekly Variability In Gross Income, Price And Quantity For Hogs and Cattle

This section on short-run variability did not follow exactly the analysis of the foregoing sections of this chapter. Instead of using farm cash receipts as a proxy for gross income, price and quantity were multiplied to obtain a gross income statistic. The slaughter (quantity) data for cattle and hogs were for federally inspected establishments. The cattle prices were calculated as the average of Calgary and Edmonton prices for A1,2 steers for Alberta while the price for Canada was calculated as the average of Calgary, Edmonton, Saskatoon, Winnipeg, Toronto, and Montreal prices for A1,2 steers. The prices for hogs were calculated as the average of index 100 dressed prices for the same cities (ie., the average of Calgary and Edmonton index 100 prices were termed the Alberta price while the price for Canada was taken to be the average of Calgary, Edmonton, Saskatoon, Winnipeg, Toronto, and Montreal prices).

The degree of variability of the weekly prices, quantities and gross incomes are illustrated in Tables 4.13, 4.14, 4.15 and 4.16. The analysis of weekly gross income from hog production for Alberta and Canada resulted in the observation that there was little indication of trend for 1973 and 1974. For example, the C.V.C.T. for gross income from hogs was estimated to be 14.56 percent for Canada while the coefficient of variation was estimated to be 14.65 percent, an insignificant difference. However, the analysis of the annual data for Canada illustrated that there was a significant trend over time. For example, the C.V.C.T. estimated for gross income from hog production in Canada was 23.02 percent compared to the estimated coefficient of variation of 36.26 percent. Thus,

there was no discernible trend in gross income, slaugterings and prices in Canada and Alberta for hog producers in the short-run. The same was true for the gross income from cattle and the slaughterings and prices of cattle in Alberta and Canada (eg., the estimated C.V.C.T. for weekly gross income of cattle producers in Canada was 15.81 percent while the estimated coefficient of variation was 16.75 percent).

Table 4.13

PERCENTAGE DEGREE OF VARIABILITY OF WEEKLY CANADIAN HOG PRODUCER INCOMES, PRICES AND SLAUGHTERINGS, BY WEEK 1973 AND 1974

	Income	Slaughterings	Price
	%	%	%
Coefficient of Variation	14.65	11.75	13.62
Coefficient of Variation Corrected for Trend	14.56	11.60	13.55
Instability Index	16.31	15.82	3.25

Table 4.14

PERCENTAGE DEGREE OF VARIABILITY OF WEEKLY ALBERTA HOG PRODUCER INCOMES, PRICES AND SLAUGHTERINGS, BY WEEK, 1973 AND 1974

	Income	Slaughterings	Price
	%	%	%
Coefficient of Variation	19.72	22.80	15.43
Coefficient of Variation Corrected for Trend	18.33	21.66	15.35
Instability Index	41.08	41.08	4.75

Table 4.15

PERCENTAGE DEGREE OF VARIABILITY OF WEEKLY CANADIAN CATTLE PRODUCER INCOMES, PRICES, AND SLAUGHTERINGS, 1973 AND 1974

	Income	Slaughterings	Price
	%	%	%
Coefficient of Variation	16.75	12.89	9.01
Coefficient of Variation Corrected for Trend	15.81	12.59	8.63
Instability Index	22.37	14.44	9.96

Table 4.16

PERCENTAGE DEGREE OF VARIABILITY OF WEEKLY ALBERTAN CATTLE PRODUCER INCOMES, PRICES, AND SLAUGHTERINGS, 1973 AND 1974

	Income	Slaughterings	Price
	%	%	%
Coefficient of Variation	19.08	17.92	6.73
Coefficient of Variation Corrected for Trend	17.87	17.72	5.86
Instability Index	18.95	19.66	3.12

It was also noted that the variability of the short-run (ie., weekly) gross income and prices from hog production in Alberta and Canada was less than the variability of the long run (ie., annual) gross income and prices for these producers. For example, the estimated short-run C.V.C.T. for gross income from hog production in Canada was 14.56 percent and the estimated coefficient of variation corrected for trend

for hog prices in Canada was only 13.55 percent while the estimated long-run C.V.C.T. for gross income from hog production was 23.02 percent and the estimated long-run C.V.C.T. for hog prices in Canada was only 20.78 percent. However, the estimated coefficient (the C.V.C.T.) of weekly hog slaughterings was 21.66 percent compared to the estimated C.V.C.T. of yearly hog slaughterings of 14.22 percent in Alberta. A similar tendency appeared for the estimated degree of variability of gross income, prices and slaughterings of cattle in Canada and Alberta. These results indicated that in the short-run, slaughterings may be the prime cause of gross income variability in contrast to the long-run situation, where price variability was estimated to be the major cause of gross income variability for producers of cattle and of hogs.

The separation of gross income variability into its component parts is illustrated in Table 4.17. The procedure followed for the analysis of the weekly data was the same as that used for the analysis of the annual data.

The major cause of weekly gross income variability for cattle and hog producers in Canada and Alberta was estimated to be the variability in weekly slaughter. This is in contrast to the estimated result of the analysis of the annual data. For example, an estimated 56.23 percent and 70.99 percent of weekly gross income variability for hog producers in Canada and Alberta was caused by variability in slaughtering (ie.,quantity), while in contrast,only an estimated 24.99 percent and 29.0 percent of annual gross income variability for hog producers in Canada and Alberta was caused by hog slaughterings from 1950 to 1973. In addition, an estimated 68.02 percent of weekly gross income

variability of cattle production in Canada was caused by quantity variability while only 16.84 percent of gross income variation was estimated to have been caused by quantity variability from 1950 to 1973. Comparable figures for Alberta were an estimated 69.0 percent in the short-run and an estimated 9.48 percent in the long-run.

Table 4.17

DEGREE OF WEEKLY GROSS INCOME VARIABILITY FROM HOG AND CATTLE PRODUCTION CAUSED BY VARIABILITY OF PRICE AND VARIABILITY OF SLAUGHTERING IN ALBERTA AND CANADA, 1973 AND 1974

Amount of Income Variation Attributable to:		Hogs Canada	Hogs Alberta	Cattle Canada	Cattle Alberta
		%	%	%	%
Price	$\frac{A}{A+B}$	43.77	29.01	31.98	31.00
Quantity	$\frac{B}{A+B}$	56.23	70.99	68.02	69.00
Linear Interaction	$\frac{C}{A+B}$	25.45	51.40	30.70	23.01

The implication of the different results of the long-run and short-run analysis is that stabilization policies dealing with short-run problems (ie.,week-to-week problems) should try to stabilize supplies coming to market, whereas a long-run stabilization program should concern itself mainly with stabilizing prices that producers receive. However, it should be noted that the analysis of the long-run and the short-run situations differed slightly. This may have affected the foregoing results. Possible reasons for the differences are discussed below.

Possible Explanations for the Differences in Short and Long-Run Results

The feature that there is no discernible trend in

any of the short-run variables was not of great importance or interest. Of more importance is the feature that price variability appears to be the major contributor to gross income variability for cattle and hog producers in the long-run, whereas quantity variability appears to be the major cause of gross income variability for cattle and hog producers in the short-run.

One possible explanation of this difference for slaughterings is that some degree of variability in slaughterings was masked when using annual data. However, if a stabilization program is only directed at aggregate annual income of a commodity, the within-year variability in slaughtering may be of little consequence.[1]

A second possible explanation of the differences in the short and long-run results arises from the slightly different sets of data used for each analysis. In the analysis of annual data, gross annual income was represented by farm cash receipts from the particular farming operation and price was represented by farm cash receipts divided by the quantity of meat slaughtered for a particular year. In the analysis of weekly data, gross weekly income was represented by price times quantity of slaughter. Thus, the data for the long-run analysis accounts for changes in slaughter weights of the animals, (ie. farm cash receipts = price x quantity x weight), whereas in the short-run analysis, the possibility that changes in slaughter weights of the animals could alter total revenue and thus alter the income statistic was not

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[1] While this may be true for producers, packing plants would most surely argue against this point.

considered. If the slaughter weights of the animals has varied significantly over time this may have biased the results of the analysis of apportioning the weekly gross annual income variability into its relative components. A further possible explanation of the difference in the short and long-run analysis is that this may partly arise from the difference in the time periods covered by the analysis.

There is a further explanation of the differences in results. This is that, the short-run (ie., weekly) elasticity of supply may have been greater than the long-run (ie., 12-months or more) elasticity of supply. This explanation is intuitively attractive in that there are seasonal slaughtering patterns for cattle and hogs and this may result in a higher elasticity of supply for periods of under twelve months. In addition, a producer may be able to withhold his product from the market for a few weeks if he thinks prices will rise in the near future. Since this option is not available over the long-run, week-to-week slaughterings may be much more variable than annual slaughterings, and this was, in fact, shown to be true.

The results of the analyses of the degree of variability and the major source of gross income variability outlined in the chapter provide some implications which should be considered when devising a stabilization policy. The following chapter outlines the results of further investigation into the possible implications and effectiveness of some stabilization programs for hog producers in Canada.

CHAPTER V

EFFECTIVENESS OF HOG STABILIZATION PROGRAMS

Introduction

In Chapter IV the extent of price, quantity and income variability was measured in the short-run (ie., week-to-week) and in the long-run (ie., year-to-year variability)for twenty-four years. In addition, the income variability was apportioned between quantity and price variability; that is, an attempt was made to find the dominant source of income (total revenue) variability, be it price or quantity variability.

In this chapter, an attempt is made to determine the degree of effectiveness a price stabilization scheme might have on smoothing out income fluctuations for hog producers in Canada, Alberta, Eastern Canada and Western Canada. At the same time, an attempt is made to ascertain the effectiveness of the Federal Government's 1974 to 1975 Hog Stabilization program (described in Chapter II).

For this chapter a number of supply functions were estimated in order to calculate point elasticities which were used to estimate a supply response to a hypothesized price (or margin) change caused by a stabilization policy. Once the supply response was calculated the cumulative effect of changes in price and quantity on total revenue could be estimated.

For analytical and comparative purposes two other supply response studies were cited. Their estimates of supply elasticities were utilized along with the elasticities estimated in this study. The first study, undertaken by research economists at Agriculture Canada,

involved the estimation of national and regional hog supply functions.[1] The second study estimated supply functions for Eastern and Western Canada which were developed in the context of a quarterly quadratic programming model.[2]

Elasticity Estimates From Two Prior Studies

Chin, Pando and West - National and Regional Hog Supply Functions

The stated objectives of the analysis by Chin, Pando and West were, "... to describe the factors which influence the level of hog production at the national and regional level, and to measure the effects of changes in these factors on the number of hogs produced."[3] They also stated that: "... these estimates are useful in outlook work and in analyzing the effects of government policies on producer prices, production and income, regional location of production, exports and imports, and related variables."[4]

Chin, Pando and West estimated their supply functions on a semi-annual basis and specified the number of hogs produced as a function of the lagged prices of hogs, lagged opportunity costs as represented by the margin between the average prices of good feeder steers and

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[1] S.B. Chin, J.L. Pando and D.A. West. National and Regional Hog Supply Functions, Economics Branch Publication No. 74/15 (Ottawa: Agriculture Canada, September 1974).

[2] A.C. Zwart and Larry Martin. The North American Pork Sector Analysis of Its Economic Interrelationships and a Model for Policy Evaluation, Publication No. AE 74/10 (Guelph: School of Agricultural Economics and Extension Education, University of Guelph, 1974).

[3] Chin, Pando and West, Op. Cit., p. 1.

[4] Ibid., p. 1.

choice slaughter steers, lagged price of feed grains, a time trend and a seasonal dummy variable. They also lagged the endogenous variable -- the number of hogs produced-- one period in order to illustrate, " ... the process by which the hog producer attempts to adjust his actual marketing level Q_t to his desired or equilibrium level of output Q_t^*."[1]

From their analysis of supply functions, Chin, Pando and West calculated the respective supply price elasticities. Some of their elasticity estimates were utilized in this study. These are summarized in Table 5.1.

Table 5.1

ESTIMATED ELASTICITIES OF CHIN, PANDO, AND WEST FROM NATIONAL AND REGIONAL HOG SUPPLY FUNCTIONS.

Region	Short-Run Price Elasticity of Supply	Long-Run Price Elasticity of Supply	Stocks of Grain Elasticity of Supply	Cross Elasticity with the Price of Corn
Canada	.36	.61	.08	
Alberta	.42	1.02	.08	
Eastern Canada	.39	.87		-.10
Western Canada	.40	.85	.19	

Source: C.S. Chin, J.L. Pando, and D.A. West. National and Regional Hog Supply Functions, Economics Branch Publication No. 74/15 (Ottawa: Agriculture Canada, September 1974), p. 55.

[1] Chin, Pando and West, Op. Cit. p. 28

Zwart and Martin - The North American Pork Sector

This study had three stated objectives:

(1) To describe and analyze the major factors which affect supply, demand and prices in the North American pork sector;

(2) To construct a spatial and temporal model of the North American pork sector in which the relationships derived in objective (1) can be incorporated to explain changes in Canada's production, prices, storage, consumption and trade of pork products;

(3) To illustrate the usefulness of the model in evaluating the effects of policy changes on the Canadian pork sector.[1]

The supply functions which they postulated for Eastern and Western Canada were quarterly functions where the quantity of hogs slaughtered was a function of lagged hog prices, lagged feed grain prices (or stocks of grain), a lagged opportunity cost variable which was the margin between the price of a choice slaughter steer and a good feeder steer, a lagged endogenous variable and a set of seasonal dummy variables. The independent variables used by Zwart and Martin were similar to those used by Chin, Pando and West, but the length of the lags utilized differed between studies. From these supply functions, Zwart and Martin estimated the elasticities summarized in Table 5.2. For the purposes of this study, hog supply functions were estimated on a quarterly basis for Canada, Alberta, Eastern Canada and Western Canada, using data for twenty-five years, 1950 to 1974.

Specification of the Regional Supply Functions

Theoretical Considerations

The structure of the supply function postulated in this study

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[1] Zwart and Martin, Op. Cit., p. 1.

Table 5.2

ESTIMATED ELASTICITIES BY ZWART AND MARTIN FOR THE NORTH AMERICAN PORK SECTOR

	Eastern Canada	Western Canada
Hog Price		
Short-Run	.22	.10*
Long-Run	.89	.20*
Feed Price or Feed Stocks		
Short-Run	-.03*	.19
Long-Run	-.12*	.37

* Estimated from statistically insignificant regression coefficient.

Source: A.C. Zwart and Harry Martin, The North American Pork Sector: Analysis of Its Economic Interrelationships and a Model for Policy Evaluation, Publication No. AE 74/10 (Guelph: School of Agricultural Economics and Extension Education, University of Guelph 1974).

is based on the adaptive expectations model. [1] The adaptive expectations model suggests that a producer formulates his production decisions based on the expected value of a variable. For example, a hog producer is assumed to have based his production decision on the price which he expects to receive when his hog are mature. In notational form this can be denoted as:

$$Qt = a + B\ P^*_{t-n} + Ut \qquad (7)$$

[1] Marc Nerlove, "Adaptive Expectations and Cobweb Phenomena," Quarterly Journal of Economics, Vol. 72 (1958), pp. 227-240.

where:

Q_t = the quantity of hogs produced in period t;

P^*_{t-n} = the expected price, and

U_t = the disturbance term.

Since the expected price P^*_{t-n} is an unobservable value, an assumption must be made on how the expected price is formulated by the producer. The common assumption of the adaptive expectations hypothesis is that expectations are revised in each time period by a fraction of the difference between the actual value of the variable and the expected value of the variable. In other words, it is assumed that the producer will change his price prediction for a following period of time by a certain fraction of the difference between what he thought the price would be and what the price actually turned out to be. In notational form this can be expressed as:

$$P^*_{t-n} - P^*_{t-n-1} = C(P_t - P^*_{t-n-1}) \qquad (8)$$

where:

C = the estimated fraction by which producers re-estimate future price, and

P_t = the actual (observed) price in time period t.

Utilizing a Koyck transformation to combine equations (7) and (8), a new supply function can be estimated whereby the quantity of hogs produced is expressed as a function of a set of lagged observable variables.[1] In notational form the general supply function can be denoted as:

$$Q_t = a(1-\lambda) + B(1-\lambda)\ P_{t-n} + \lambda Q_{t-1} + (U_t - \lambda U_{t-1}) \qquad (9)$$

where:

Q_t = the quantity of hogs produced in period t.

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[1] The Koyck transformation method is described by J. Johnston, Econometric Methods Second Edition;(New York: McGraw-Hill Book Company, 1972), pp. 298-303.

P_{t-n} = the actual price of hogs in time period t-n; and

Q_{t-n} = the quantity of hogs produced in the previous time period.

By including the endogenous variable on the right hand side of (9), one distributes the effect of price changes over a number of periods, that is, a distributed lag comes into effect.

A problem with this type of model is that the function, when estimated by ordinary least squares, violates the assumption that the disturbance term is randomly distributed with a mean of zero and a constant variance. Thus, the estimated parameters will be biased and inconsistent.

There are a number of ways to mitigate this problem. One can estimate the parameters by ordinary least squares and adjust the estimated B coefficients by dividing these by the estimated λ coefficient of the lagged endogenous variable. Another method would be to select values of the λ variables between zero and one and to adjust the values of the explanatory variables by these various values of λ. The functions could then be estimated using ordinary least squares and the regression which yielded the minimum sum of squares of deviations from the mean of the dependent variable could be chosen as the representative function.

In this study, the first alternative was chosen as this estimation procedure facilitates the estimation of long-run elasticities. This procedure was utilized by Zwart and Martin in their study of the North American pork sector.

Specification of the Explanatory Variables

The various regional supply functions were estimated using

ordinary least squares with the assumption that a linear relationship prevailed between the dependent variable, hog slaughter at inspected establishments, and the independent variables lagged five quarters (15 months). The postulated general supply function was:

$$HS_i = a_i + B_{1i}HP_{it-5} + B_{2i}GS_{it-5} + B_{3i}CP_{it-5} + B_4T + A_iHS_{it-1}, \quad B_5D_1 + B_6D_2 + B_7D_3 + U_i \qquad (10)$$

where:

HS_i = the number of hogs slaughtered in federally inspected establishments on a quarterly basis for the years 1950 to 1974 (i = region 1 to region 4, ie., Canada was designated as region 1, Alberta was designated as region 2, Eastern Canada was designated as region 3, and Western Canada was designated as region 4),

HP_i = the price of index 100 or Grade A hogs for the years 1948 to 1974, on a quarterly basis. In order to ascertain the effect of income on the dependent variable, a "value-added" variable was calculated and the regressions were re-estimated after having replaced the price variable with the "value-added" variable. The calculation of the "value-added" variable is explained in the section following,

GS_i = the stocks of grain (wheat, oats and barley) on farms on a quarterly basis.

CP_i = the price of Ontario No. 2 corn bought on a carload basis F.O.B. Chatham, Ontario. This variable was interchanged with the grain stocks variable for Eastern

Canada as it was hypothesized that Eastern Canada hog producers react more to change in corn costs than they would to changes in other feed grains,

T = represents a linear time trend used to account for such factors as technological changes, T = 1 ... 25,

D_1, D_2, D_3 = included as seasonal dummy variables in an attempt to ascertain any seasonal affects on production. (In the first quarter -- $D_1 = 1$, $D_2 = 0$, $D_3 = 0$; in the second quarter -- $D_1 = 0$, $D_2 = 1$, $D_3 = 0$; in the third quarter -- $D_1 = 0$, $D_2 = 0$, $D_3 = 1$; and in the fourth quarter -- $D_1 = D_2 = D_3 = 0$.)

It was expected that hog slaughter (HS) would vary in a positive manner with the price or "value-added" variables. That is, as price or profitability ("value-added") rose, supply (slaughtering) could be expected to increase five quarters later.[1] It was also expected that hog slaughter would vary directly with the availability of grain stocks. The grain stocks variable was used rather than feed grain prices due to the unavailability of "off-board" grain prices. These "off-board" prices

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[1] Hog prices were compiled from: Agriculture Canada, Livestock Market Review, (Ottawa, Markets Information Section, Production and Marketing Branch, various issues). The explanatory hog price variable postulated for Canada was the average of reported terminal market prices of Toronto, Montreal, Calgary, Edmonton, Winnipeg and a Saskatchewan market (either Regina, Moose Jaw or Saskatoon). The Alberta explanatory hog price variable is the average of Calgary and Edmonton reported terminal market prices. The Eastern Canada explanatory hog price variable is the average of the reported terminal market prices for Toronto and Montreal. The Western Canada explanatory hog price market variable is the average of reported terminal market prices for Winnipeg, Calgary, Edmonton and a Saskatchewan market.

were the relevant prices for western producers in the past. But since these prices were usually not recorded, and it is known that the price of grain varied inversely with the available quantity of grain, stocks of feed grains were used as a proxy for feed grain prices and were expected to have a positive effect on the manner in which hog slaughterings varied.[1]

Eastern hog producers, on the other hand, utilized corn more than barley as a feed grain for hogs. Thus, it was expected that hog slaughterings would decrease five quarters after the price of corn had increased-- an inverse relationship.[2]

It was expected that the trend variable (T) would have a positive coefficient as production techniques and management practices have changed substantially in the last twenty-five years and that these changes have resulted in increased production over time.

Calculation of the Value-Added Variable

The "value-added" variable was calculated in the following manner:

1) The feed cost necessary to grow a fifty pound weaner to market weight was calculated for each region.

2) The feed cost for Western Canada and Alberta was based on 506 pounds of barley plus 42 pounds of soybean supplement per hog on a 13 percent protein diet, while the feed cost calculation for Canada and Eastern Canada was based on 253 pounds of barley, 253 pounds of corn

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[1] Stocks of feed grains on farms were compiled from: Statistices Canada, Coarse Grains Review, Cat. No. 22-001, (Ottawa: various issues.

[2] Corn prices were compiled from: Dominion Bureau of Statistics, Canada Grain Trade, Cat. No. 22-201 (Ottawa: various issues).

and 42 pounds of soybean supplement.[1]

3) The quantities of feed were multiplied by their various reported market prices (eg. corn price was taken as the price of No. 2 corn bought on a carload basis, F.O.B. Chatham, Ontario) and divided by 1.65 to reduce the feed costs to a dressed weight basis, comparable to the reported terminal hog market prices, since the warm dressed weight of a market hog usually averages about 165 pounds. Thus, since the feed cost was calculated on a per hog basis, dividing by 1.65 reduces the feed cost to a per hundredweight dressed hog basis.

4) The feed cost on a per hundredweight dressed basis was subtracted from the reported terminal market per hundredweight index 100 price for each quarter to obtain a margin or "value-added" measure. The "value-added" measure was a type of crude profitability measure and was substituted into the regional hog supply functions in place of the hog price variable on the assumption that producers made their production decisions on the basis of some measure of profit rather than simply on a measure of price. In addition, substituting the "value-added" variable into the supply function facilitated the estimation of the production response to this variable which is of interest since "value-added" was the basis of the Federal Government's hog stabilization program of 1974-1975.

Empirical Results and Calculated Elasticities

For each region under study, two regression equations were estimated using ordinary least squares. The first equation contained the reported terminal market price of index 100 hogs as one of the explanatory

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[1] The quantities of feed used for this study were similar to the quantities used in calculating the historical margin of the Federal Government's hog stabilization program of 1974-1975.

variables in the hog supply function. For the second regression equation, the price of hogs was replaced by the "value-added" variable. The independent variable and the other explanatory variables were unchanged.

The Canadian hog supply function-- This equation was estimated with federally inspected hog slaughter postulated as the dependent variable. This was regressed on hog price lagged five quarters, grain stocks lagged five quarters, corn price lagged five quarters, a linear trend variable, a set of seasonal dummy variables and the dependent variable lagged one quarter. The estimated result was:

$$\begin{aligned} HSCA = {} & 88523.975 + 79.932\ HPCA - 810.184\ CPCA + .214\ GSCA + 1599.636\ T \\ & \quad (.872) \qquad (2.639) \qquad (-1.399) \qquad (2.999) \qquad (1.754) \\ & + 380490.36\ FQD + 207606.58\ SQD + 165601.98\ TQD + .66\ HSCA_{t-1} \\ & \quad (9.342) \qquad (5.372) \qquad (4.229) \qquad (8.803) \end{aligned} \tag{11}$$

$R^2 = .903$

where:

HSCA = the level of quarterly federally inspected hog slaughter in Canada,

HPCA = the quarterly hog price average for six markets, Canada,

CPCA = the quarterly corn price average F.O.B. Chatham, Ontario,

GSCA = the quarterly stocks of grain on farms in Canada,

T = the linear trend,

FQD, SQD, TQD = the first, second and third quarter dummy variables, respectively, and

$HSCA_{t-1}$ = the dependent variable lagged one quarter.

The t values are indicated in the brackets.

The signs on the regression coefficients were consistent with economic logic and indicate that supply was directly related to hog price, inversely related to the price of corn, and directly related to stocks of grains on farms. In addition, the estimated regression coefficients were all significantly different from zero at the 95 percent level except for the corn price variable and the trend. The estimated coefficient for the corn price variable was significantly different from zero at the 90 percent confidence level. The coefficient of determination (R^2) indicates that 90.3 percent of the variance of the dependent variable was explained. The results also indicate that the slaughter of hogs in one period is affected by the slaughter in the previous period as indicated by the estimated coefficient of 0.66 on the variable $HSCA_{t-1}$.

The second supply function was estimated using the "value-added" variable as an explanatory variable in place of the hog price variable. The result was:

$$HSCA = 107974.98 + 80.07\ VACA - 110.235\ GPCA + .213\ CPCA + 1817.737\ T$$
$$(1.076) \qquad (2.677) \qquad (-.239) \qquad (2.994) \qquad (2.044)$$
$$+ 373292.49\ FQD + 210526.38\ SQD + 16723.02\ TQD + .652\ HSCA_{t-1} \qquad (12)$$
$$(9.155) \qquad (5.456) \qquad (4.279) \qquad (8.673)$$
$$R^2 = 90.4$$

where:

VACA = the quarterly "value-added" (margin) variable calculated for Canada, and all other designations were as for equation (11).

The t values are indicated in the brackets.

The results of equation (12) differed little from those of equation (11). The sign on the estimated coefficient for the "value-added" variable was positive and significantly different from zero at the 95 percent confidence level. The estimated coefficient for the corn price variable was no longer significant but the estimated coefficient for the trend variable was significant at the 95 percent confidence level. The inclusion of the "value-added" variable did not improve the degree of explanation of the variance of supply as the R^2 did not increase and the regression coefficients on most of the explanatory variables did not change appreciably.

The Alberta hog supply functions-- These functions were estimated in a fashion similar to the Canadian hog supply functions. The estimated result using price as an explanatory variable was:

$$\begin{aligned} HSAL = {} & -5204.997 + .137\ HPAL + .098\ GSAL + 297.621\ T + 1011181.21\ FQD \\ & \qquad (.021) \qquad (1.41) \qquad (1.41) \qquad (8.565) \\ & + 88177.489\ SQD + 73557.779\ TQD + .736\ HSAL_{t-1} \qquad (13) \\ & \quad (8.411) \qquad (7.129) \qquad (9.09) \end{aligned}$$

$R^2 = .847$

where:

HSAL = the quarterly level of federally inspected hog slaughter in Alberta,

HPAL = the quarterly average hog price in Calgary and Edmonton,

GSAL = the quarterly grain stocks on farms in Alberta, and the rest of the variables were the same as those in equations (11) and (12).

The t values are indicated in the brackets.

In equation (13), the signs on the estimated coefficients conform to economic logic but the estimated coefficient for the hog price variable is not significantly different from zero. In addition, the estimated coefficient on the grain stocks variable is significant only at a low confidence level (ie., 80 percent). In equation (13), the slaughter of hogs in one period is dependent upon the slaughter of hogs in the previous period as indicated by the coefficient of 0.736 on the variable $HSAL_{t-1}$.

When the "value-added" variable was substituted for the hog price variable and the supply function was re-estimated, the estimated regression results did not differ appreciably from the estimated results in equation (13). The estimated result was:

$$HSAL = -15024.608 + 6.515\ VAAL + .091\ GSAL + 259.857\ T + 101862.84\ FQD$$
$$(-.652) \qquad (.917) \qquad (1.337) \qquad (1.269) \qquad (8.718)$$
$$+ 88715.815\ SQD + 74635.511\ TQD + .747\ HSAL_{t-1}. \qquad (14)$$
$$(8.528) \qquad (7.266) \qquad (9.644)$$

$R^2 = .848.$

where:

VAAL = the quarterly "value-added" (margin) variable calculated for Alberta, and all other designations were as for equation (13).

The t values are indicated in the brackets.

The Eastern Canadian hog supply functions-- These functions were estimated in the same manner as were the supply functions for Canada and Alberta. Using hog price as a explanatory variable, the result was:

$$HSEC = 32003.516 + 44.427\ HPEC - 349.511\ CPCA + 1376.64\ T$$
$$\qquad\quad (.634) \qquad (2.815) \qquad (-1.908) \qquad (2.514)$$
$$+ 141786.07\ FQD + 406698.23\ SQD + 23998.552\ TQD + .740\ HSEC_{t-1}. \qquad (15)$$
$$\quad (6.767) \qquad (1.908) \qquad (1.138) \qquad (10.503)$$
$$R^2 = .903$$

where:

HSEC = the quarterly level federally inspected hog slaughter in Eastern Canada,

HPEC = the quarterly average price of index 100 hogs in Toronto and Montreal,

CPCA = the quarterly price of corn for Canada,

$HSEC_{t-1}$ = the independent variable lagged one quarter.

The t values are indicated in the brackets.

The estimated results, shown in equation (15), indicated that hog production seems more sensitive to the price of hogs in Eastern Canada than in Alberta. This feature was indicated by the significance of the estimated coefficient for the hog price variable which was significantly different from zero at the 95 percent confidence level. The estimated coefficient for the corn price variable is of the right sign, expected from economic logic, but is not significantly different from zero. The seasonal effects in Eastern Canada appear to be somewhat more pronounced than in Canada and in Alberta. The estimated coefficient for the second quarter dummy variable in equation (15) was significant at the 90 percent confidence level. The estimated coefficient for the first quarter dummy variable in equation (15) was significant at the 95 percent confidence level.

Equation (15) was re-estimated, as it was for the previous two regions, using the "value-added" variable in place of the price of hogs. The result was:

$$HSEC = 42950.497 + 40.755\ VAEC + 39.655\ CPCA + 1484.303\ T + 140007.85\ FQD$$
$$(.857) \qquad (2.544) \qquad (.149) \qquad (2.723) \qquad (6.637)$$
$$+ 40094.354\ SQD + 23693.973\ TQD + .739\ HSEC_{t-1}. \qquad (16)$$
$$(1.865) \qquad (1.115) \qquad (10.419)$$

$R^2 = .900$

where:

VAEC = the "value-added" variable calculated for Eastern Canada, and all other variables were as designated in equation (15).

The t values are indicated in the brackets.

There was little difference in the estimated results of equation (16) and (15). In equation (16), the estimated coefficent for the "value-added" variable was significantly different from zero, but the estimated coefficient for the corn price variable had a sign opposite to that expected. This coefficient was not, however, significantly different from zero. The coefficient of determination (R^2) in equation (16) is not appreciably different from the R^2 in equation (15). The estimated coefficient on the lagged dependent variable ($HSEC_{t-1}$) in both equations indicated that the dependence of hog slaughter on the slaughter of the immediately preceding quarter was high.

The Western Canadian hog supply function-- These functions were estimated in the same manner as were the previous six estimated equations. Using the hog price variable as an explanatory variable in the postulated relationship, the estimated result was:

$$HSWC = 23092.785 + 14.054\ HPWC + .177\ GSCA + 428.044\ T + 222964.24\ FQD$$
$$(.379) \qquad (.909) \qquad (3.376) \qquad (.879) \qquad (7.984)$$
$$+ 157549.11\ SQD + 131389.96\ TQD + .606\ HSWC_{t-1}. \qquad (17)$$
$$(6.143) \qquad (5.045) \qquad (7.339)$$
$$R^2 = .838$$

where:

HSWC = the quarterly amount of federally inspected hog slaughter in Western Canada.

HPWC = the quarterly average price of index 100 hogs in Calgary, Edmonton, Winnipeg and a Saskatchewan market.

GSCA = the quarterly level grain stocks on farms in Canada, and

$HSWC_{t-1}$ = the dependent variable lagged one quarter.

The t values are indicated in the brackets.

The estimated coefficient on the hog price variable had the proper sign, as dictated by economic logic, but it was not significantly different from zero. The estimated coefficient on the grain stocks variable had the expected sign and was significantly different from zero at the 95 percent level of confidence. The estimated coefficient on the trend variable was not significantly different from zero indicating that hog slaughter in Western Canada had not significantly increased in a linear manner over time. The estimated coefficient for the lagged dependent variable ($HSWC_{t-1}$) indicated that the amount of hog slaughter in Western Canada was affected less by the amount of hog slaughter in the immediately preceding quarter than was the case in Eastern Canada. That is, the estimated coefficient on the lagged dependent variable for Eastern Canada (equation (15)), was 0.740 while the estimated coefficient

on the lagged dependent variable for Western Canada (equation (17)), was 0.606. The estimated coefficient of determination (R^2) for equation (17) was lower than those for Eastern Canada, (equation (15) and (16))-- 83.8 percent compared to 90.2 percent in equation (15) and 90.0 percent in equation (16). However, the R^2 in equation (17) was very similar to the R^2 for equations (13) and (14)-- 84.7 percent and 84.8 percent, respectively. Thus, the degree of explanation of the variance of supply in Western Canada was very similar to the degree of explanation of the variance of supply in Alberta.

In re-estimating equation (17), use of the "value-added" variable in place of the hog price variable gave the following result:

$$\begin{aligned} HSWC = {} & 22929.215 + 37.737\ VAWC + .183\ GSCA + 333.044\ T + 221671.74\ FQD \\ & (.479) \qquad (2.16) \qquad (3.569) \qquad (.709) \qquad (8.099) \\ & + 158607\ SQD + 135682.33\ TQD + .592\ HSWC_{t-1}. \qquad (18) \\ & (6.312) \qquad (5.306) \qquad (7.310) \end{aligned}$$

$R^2 = .844$

where:

VAWC = the quarterly "value-added" variable calculated for Western Canada, and all the other variables were as designated in equation (17).

The t values are indicated in the brackets.

The estimated coefficient on the "value-added" variable in equation (18) was significantly different from zero at the 95 percent confidence level, a sharp contrast to equation (17) where the estimated coefficient on the hog price variable was not significantly different from zero. Other than that there was very little difference between the

estimated results of equations (17) and (18).

The Durbin - Watson statistic was not calculated because when the lagged dependent variable is used as an explanatory variable, the Durbin - Watson statistic is consistently over-estimated. That is, any calculation of the Durbin - Watson statistic is biased when a lagged dependent variable is included as an independent variable.[1]

Elasticities Calculated for the four regions-- From the results estimated for equations (11) to (18), a number of price and "value-added" elasticities were calculated. These elasticities, calculated at their respective means, are summarized in Table 5.3.

Table 5.3

SUMMARY OF ESTIMATED RESPONSE ELASTICITIES FOR HOG SLAUGHTER, LONG RUN AND SHORT RUN

	Canada	Alberta	Eastern Canada	Western Canada
Short Run				
Hog Price Elasticity	.14	.001*	.15	.06*
Value Added Elasticity	.07	.03*	.07	.07
Corn Price Elasticity	-.08*		-.07	
Grain Stocks Elasticity	.05	.03*		.10
Long Run				
Hog Price Elasticity	.42	.004*	.58	.15*
Value Added Elasticity	.20	.12*	.27	.17
Corn Price Elasticity	-.24*		-.27*	
Grain Stocks Elasticity	.15	.11*		.25

* Estimated from statistically insignificant regression coefficient.

[1] Johnston, Op. Cit., p. 313

The long-run elasticities were calculated using:

$$E_{LR} = \frac{E_{SR}}{1-b} \qquad (19)$$

where:

E_{LR} = the long-run elasticity estimate

E_{SR} = the short-run elasticity estimate, and

b = the estimated coefficient for the lagged dependent variable.

The estimated elasticities indicated that Eastern Canada production decisions, represented by hog slaughterings, were responsive to the hog price and "value-added" variable changes. Western Canada and particularly Alberta, had lower own price elasticities of supply than those estimated for Eastern Canada. This was particularly the case for the long-run elasticities (eg. the estimated long-run own price elasticity of supply for Alberta was .004 compared to .58 for Eastern Canada).

The price elasticities estimated in this study were generally lower than the elasticities estimated by Chin, Pando and West (Table 5.1). The production reponse to changes in the grain stocks variable (ie., the grain stocks elasticity) estimated for this study compared fairly closely to those estimated by Chin, Pando and West. For example in this study the short-run grain stocks variable elasticity estimated for Canada was .05, while the elasticity estimated by Chin, Pando and West was .08.

The price elasticities estimated by Zwart and Martin (Table 5.2) also tended to be slightly higher than the price elasticities estimated in this study, particularly for Eastern Canada. The short-run grain stocks variable elasticity estimated by Zwart and Martin for Western

Canada (.19) was also slightly higher than the estimate in this study (.10).

The estimates of cross elasticities of supply with respect to corn price from this study were calculated from non-significant estimated coefficients and the results were -.08 and -.07 for Canada and Eastern Canada respectively in the short-run. The Zwart and Martin cross elasticity with respect to the corn price estimate was -.03 for Eastern Canada in the short-run while the Chin, Pando and West corn price elasticity estimate was higher than those estimated in the Zwart and Martin study and this study. The Chin, Pando and West estimate was -.10 and was calculated from a statistically significant coefficient.

Although there are price elasticity estimates for hogs available from other sources there are no comparable "value-added" elasticity estimates. Using the elasticities estimated by this study and the other two studies, the next section of Chapter V analyzes certain cumulative impacts of stabilization policies on various regions of Canada.

Stabilization Effect on Total Revenue and Net Revenue

Using estimated supply elasticities from various sources, it was possible to estimate the percentage impact than an increase in price (applied through a deficiency payment or price support program) would have on total revenue. The resulting percentage increase in total revenue was estimated by adding the percentage increase in supply to the hypothesized percentage increase in price and an interaction term. This prodecure involved the assumption that intervention in the prices paid to producers (whether by maintenance of the support price or by a deficiency payment program) would maintain the hypothesized increased price level following the increase in market supplies which resulted

from the higher prices. If this assumption did not hold-- that is, the stabilization program was only a temporary program--the hypothesized price increase resulting from a stabilization program would lead to an increase in supply (to the extent of the price elasticity of supply), which in turn would lead to a decrease in price (to the extent dictated by the price elasticity of demand), which in the following periods would at least partially off-set the initial increase in total revenue. However, this analysis was based on the supposition that the initial assumption held true.

Similarly, the effect of a stabilization program on net revenue could be calculated using the estimated "value-added" elasticities. Since "value-added" was defined as the hog price minus feed costs, the "value-added" variable multiplied by quantity approximates net revenue. Thus, the same procedure as that used to estimate the percentage change in total revenue was used to estimate the change in net revenue.

Tables 5.4 and 5.5 illustrate the expected supply response to changes in price and "value-added". Table 5.4 relates the short-run supply reponse to an increase in price or "value-added" of 1 percent, 5 percent and 7 percent. Table 5.5 shows the calculated long-run supply reponse using the long-run elasticities.

It was found that in the short-run, supply increased less than the increase in prices or the "value-added" variables. Only once was this not the case-- the Chin, Pando and West elasticity estimate for Alberta where the supply response was greater than the price or the "value-added" variable change.

Tables 5.6 to 5.13 illustrate the possible increases in total revenue, (and net revenue) in the short-run and in the long-tun, depending

on the elasticities used. Tables 5.6 and 5.7 illustrate that according to the elasticities calculated by Chin, Pando and West, a 5 percent increase in prices could lead to a 6.89 percent increase in total revenue in the short-run or a 8.2025 percent increase in the long-run in Canada. The impact on net revenue was less, however, when the elasticity results of this study were used rather than those of Chin, Pando and West, in that net revenue increased 5.3675 percent in the short-run in Canada and 6.05 percent in the long-run.

The results illustrated in Tables 5.8 and 5.9 indicate that the patterns exhibited for Alberta are similar to those exhibited in the results of the analysis of the Canadian data. That is, the estimates of total revenue increase, based on the elasticity estimates of Chin, Pando and West, were greater than those based on the elasticity estimates of this study. However, the net revenue impacts using the elasticity estimates of this study were greater than the percentage total revenue increase. For example, a 5.0 percent increase in price in the short-run resulted in an estimated increase in total revenue of only 5.005 percent. However, Chin, Pando and West's elasticity estimate resulted in a short-run increase of 7.205 percent in total revenue. The "value-added" increase of 5.0 percent resulted in a short-run increase of 5.1575 percent in net revenue for Alberta. The long-run total revenue increases ranged from 5.021 percent to 10.355 percent, while net revenue was estimated to increase 5.63 percent in the long-run.

For Eastern Canada, all four elasticity estimates were used to calculate total and net revenue increases. The same was true for Western Canada. Tables 5.10 through 5.13 illustrate that price changes in Eastern Canada are likely to have a greater impact on total revenue

than in Western Canada. This also holds true for the short-run elasticity estimates of Chin, Pando and West. Use of their long-run elasticity estimates resulted in a greater impact in total revenue in Eastern Canada than in Western Canada.

Tables 5.10 to 5.13 also illustrate that net revenue in Eastern Canada could perhaps increase more than in Western Canada in the long-run if "value-added" was increased. In the short-run, a 5.0 percent increase in "value-added" brought about a 5.3675 percent increase in net revenue in Eastern Canada. By comparison, the short-run increase in net revenue in Western Canada was also 5.3675 percent, while in the long-run, net revenue increased 5.8925 percent from 5.0 percent increase in "value-added". Eastern Canada could expect to have its net revenue increased by 6.4175 percent in the long-run if "value-added" was increased by five percent.

The implication of the observation that Eastern Canada's net revenue could perhaps increase more in the long-run than in Western Canada was that a national policy designed to increase producer margins could have an inequitable effect among regions in Canada. However, it is not known if this implication holds true since the elasticities used to calculate the increases in net revenue were estimated from statistically insignificant coefficients. In addition, the difference between the two long-run impacts is not so great as to be a prime consideration when formulating a program.

Analysis of Recent Canadian Hog Stabilization Programs

Using the immediately foregoing analysis and the results illustrated in Chapter IV, it was possible to undertake a more critical analysis of three stabilization programs. The stabilization programs

analyzed were:

1) the Federal Government's hog stabilization program of 1974-1975, which guaranteed an average national producer margin of $22.41 per hundredweight over feed costs;
2) the Alberta Government's temporary hog production incentive program of February 1974 to mid-September 1974; and
3) the Prince Edward Island hog stabilization plan which still is in operation.

As noted in Chapter II, no payments were made during the Federal Government's hog stabilization program of 1974-1975 due to the fact that the national annual weighted average market margin was greater than the guaranteed margin of $22.41 per hundredweight. In other words, the timing of the program was poor and no payments were made during the months of April, May and June of 1974, when some producers were losing money. This was due to the fact that the program was run on an annual average national market margin basis. Both of these considerations illustrate that the Federal program was somewhat deficient.

If the program had been better timed so payments were made, another consideration would have arisen. This consideration was that the program would have distributed any increase in net revenue inequitably between Eastern Canada and Western Canada. If, for example, the average national market margin had been increased by 5.0 percent to $22.41 per hundredweight across Canada, an increase of 0.35 percent in production levels could have been expected in both Eastern Canada and Western Canada in the short-run (ie., fifteen months). Eventually, a 1.35 percent increase in production levels in Eastern Canada, as well as a 0.85 percent increase in production levels in Western Canada, could have been expected

in the long-run (ie., about two or more years).[1] The expected supply response, coupled with the postulated margin increase, could have led to a 5.3675 percent increase in aggregate regional net revenue from hogs in Eastern and Western Canada in the short-run, and to a 6.4175 percent increase in aggregate regional net revenue in Eastern Canada in the long-run. In Western Canada, however, the aggregate regional net revenue from hogs would be expected to increase by 5.8925 percent in the long-run. The difference between these impacts on net revenue appear to be relatively minor.

The Alberta Government's temporary hog production incentive program involved a subsidy of 75 cents for each hundred pound unit of dry feed required to produce one hundred pounds of dressed pork up to a limit of $4.50 per hundredweight dressed basis. There was no payment limit on the number of hogs to be produced by an individual. A total of $7.6 million was paid out during the period of operation of the program.[2] The average price for hogs (Calgary index 100 dressed price) during the period the program was in operation was $42.11 per hundredweight. The program raised the effective producer price about 11 percent. The likely impact on total revenue, however, amounted to an increase of 11.0122 percent in the short-run and about 11.0484 percent in the long-run. These figures were based on the estimated supply responses outlined earlier in this chapter.[3] Considering that the degree of variation in total

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[1] Increases in production levels caused by the hypothesized percent margin increase were based on the supply elasticity estimated of this study.

[2] "Temporary Hog Production Incentive Program Ends, "Alberta Hog Journal, Vol. 3, No. 4 (Fall 1974), p. 16.

[3] See Table 5.5 this chapter.

revenue was estimated as 18.33 percent in the short-run (on a week-to-week basis) and 20.46 percent in the long-run[1] (on an annual basis for twenty-four years), a change in total revenue of some 11 percent during a low point in the price cycle is substantial and the timing of the program was good. However, in retrospect, hog slaughtering was greatly reduced in 1975 and the beginning of 1976 in Alberta, which may mean greater support was needed if the objective was to maintain hog producers in business and to smooth out market supply and prices.

The Prince Edward Island hog stabilization plan initially had the base price set at $26 per hundredweight (dressed basis) and producer contributions were to be 25 cents for every dollar the price was above $31 per hundredweight, up to a maximum contribution of $1.50 per hog marketed. In February of 1974, the base price was set at $52.50 per hundredweight and the ceiling price was set at $57.50 per hundredweight. The amount to be contributed by producers was increased to 50 cents for each dollar the market price exceeded $57.50 per hundredweight, up to a maximum of $3 per hog marketed. In August of 1974, the floor price was changed to $51.75 per hundredweight and the ceiling price was changed to $56.75 per hundredweight. In November of 1974, the floor price was set at $54.00 per hundredweight and the ceiling price was set again at the usual $5 per hundredweight above the floor price.

The average market price for index 100 hogs in Prince Edward Island, from April 1973 to February 1974 was $54.03 per hundredweight. From February 1974 to August 1974, the market price averaged $44.54 per hundredweight. From August 1974 to November 1974, the average market

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[1] See Chapter IV, Tables 4.2 and 4.14.

price was $54.96 per hundredweight and from November 1974 to February 1975, the average market price was $55.75 per hundredweight.[1]

During these four periods, therefore, only in one period was a deficiency payment required under the program. In the second period - from February 1974 to August 1974 - the average market price was some 15 percent below the guaranteed floor level price. Using the estimated impact of price increases on total revenue in Eastern Canada (Table 5.10), it is concluded that there was an average increase of 17.5875 percent in producers' total revenue from hog production for those seven months.

In the period August 1974 to November 1974, the average market price fell within the range between the floor price and the ceiling price so that no contributions or deficiency payments had to be made. This was also the case during the period November 1974 to February 1975.

From the above cursory inspection of the Prince Edward Island plan, it is obvious that the plan had a relatively substantial impact on hog producers' total revenue during the second period. However, the cumulative impact, as illustrated above, would only hold true when the assumption was made that the increase in the level of hog supply brought about by the increased prices did not lead to substantially lower prices in the following periods. That is, during the period in which deficiency payments were to be made, the producers would receive 15.0 percent more total revenue due to the increased price, and would increase production by 2.25 percent. The increased production would hit the market approximately fifteen months later, and then the market price would have to be maintained at least at the level of the floor price of fifteen months earlier if the 17.5875 percent cumulative increase in total revenue was

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[1] Agriculture Canada, Livestock and Meat Trade Report (Ottawa: Market Information Services, Various issues in 1973, and 1974 and 1975.)

to be fully realized. This example illustrates the contention that a stabilization program should not be a short-term affair (ie., lasting less than a full hog cycle) if the total impact of the program is to be realized. The Prince Edward Island program seems to have that desirable feature.

Of the three programs analyzed, only the Prince Edward Island hog stabilization program seemed to be fulfilling the conditions of timeliness, regional equitability and longevity which would assure a certain degree of stability to hog producers. The Federal Government plan suffered from ill timing and possible regional inequities, while Alberta Government's program was deficient because it was not long enough to assure that an increased level of hog supplies, resulting form the increased level of hog prices did not lead to substantially lower prices in the next stage of the hog cycle. In addition, the Alberta hog incentive program was possibly deficient in that it may not have provided adequate support to stop the hog producers in Alberta from deciding to decrease supply rather than increase supply. The decreased supplies subsequently led to record high hog prices in 1975, and the influence that these very high prices will have on subsequent levels of hog supplies is as yet unknown.

Table 5.4

SUPPLY RESPONSE TO INCREASED PRICE OR "VALUE-ADDED"
USING ESTIMATED SHORT-RUN ELASTICITIES

Short-Run Price and Value Added Elasticities from Various Sources		Hypothesized Stabilization Effect on Price and Value-Added Increase 1%	Increase 5%	Increase 7%
			- Per Cent -	
This Study Price Elasticity				
Canada	.14	.14	.70	.98
Alberta	.001	.001	.005	.007
Eastern Canada	.15	.15	.75	1.05
Western Canada	.06	.06	.30	.42
Value-Added Elasticity				
Canada	.07	.07	.35	.49
Alberta	.03	.03	.15	.21
Eastern Canada	.07	.07	.35	.49
Western Canada	.07	.07	.35	.49
Chin, Pando and West Price Elasticity				
Canada	.36	.36	1.80	2.50
Alberta	.42	.42	2.10	2.90
Eastern Canada	.39	.39	1.95	2.80
Western Canada	.40	.40	2.00	2.80
Zwart and Martin Price Elasticity				
Eastern Canada	.22	.22	1.10	1.54
Western Canada	.10	.10	.50	.70

Table 5.5

SUPPLY RESPONSE TO INCREASED PRICE OR "VALUE-ADDED" USING ESTIMATED LONG-RUN ELASTICITIES

Long-Run Price and Value-Added Elasticities from Various Sources		Hypothesized Stabilization Effect on Price and Value-Added Increase 1%	Increase 5%	Increase 7%
		- Per Cent -		
This Study Price Elasticity				
Canada	.42	.42	2.10	2.94
Alberta	.004	.004	.02	.028
Eastern Canada	.58	.58	2.90	4.06
Western Canada	.15	.15	.75	1.05
Value-Added Elasticity				
Canada	.20	.20	1.00	1.40
Alberta	.12	.12	.60	.84
Eastern Canada	.27	.27	1.35	1.89
Western Canada	.17	.17	.85	1.19
Chin, Pando and West Price Elasticity				
Canada	.61	.61	3.05	4.27
Alberta	1.02	1.02	5.10	7.14
Eastern Canada	.87	.87	4.35	6.09
Western Canada	.85	.85	4.25	5.95
Zwart and Martin Price Elasticity				
Eastern Canada	.89	.89	4.45	6.23
Western Canada	.20	.20	1.00	1.40

Table 5.6

CUMULATIVE EFFECT OF STABILIZATION ON TOTAL REVENUE, CANADA, SHORT-RUN

Supply Response to Increased Price and Value-Added Calculated from Short-Run Elasticities (per cent)		Hypothesized Increase in Price and Value-Added due to Stabilization		
		Increase 1%	Increase 5%	Increase 7%
This Study Price Supply Response				
Supply Increase	.14	1.1414		
	.60		5.63	
	.98			8.0486
Value-Added Supply Response				
Supply Increase	.07	1.0707		
	.35		5.3675	
	.49			7.5243
Chin, Pando and West Price Supply Response				
Supply Increase	.36	1.3636		
	1.80		6.89	
	2.50			9.675

Table 5.7

CUMULATIVE EFFECT OF STABILIZATION ON TOTAL REVENUE CANADA, LONG-RUN

Supply Response to Increased Price and Value-Added Calculated from Long-Run Elasticities (percent)		Hypothesized Increase in Price and Value-Added Due to Stabilization		
		Increase 1%	Increase 5%	Increase 7%
This Study Price Supply Response				
Supply Increase	.42	1.4242		
	2.10		7.205	
	2.94			10.1458
Value-Added Supply Response				
Supply Increase	.20	1.2020		
	1.00		6.05	
	1.40			8.498
Chin, Pando and West Price Supply Response				
Supply Increase	.61	1.6161		
	3.05		8.2025	
	4.27			11.5639

Table 5.8

CUMULATIVE EFFECT OF STABILIZATION ON TOTAL REVENUE, ALBERTA, SHORT-RUN

Supply Response to Increased Prices and Value-Added Calculated from Short-Run Elasticities (percent)		Hypothesized Increase in Price and Value-Added Due to Stabilization		
		Increase 1%	Increase 5%	Increase 7%
This Study Price Supply Response				
Supply Increase	.001	1.001		
	.005		5.005	
	.007			7.007
Value-Added Supply Response				
Supply Increase	.03	1.03		
	.15		5.1575	
	.21			7.2247
Chin, Pando and West Price Supply Response				
Supply Increase	.42	1.424		
	2.10		7.205	
	2.90			10.103

Table 5.9

CUMULATIVE EFFECT OF STABILIZATION ON TOTAL REVENUE, ALBERTA, LONG-RUN

Supply Response to Increased Prices and Value-Added Calculated from Long-Run Elasticities (percent)		Hypothesized Increase in Price and Value-Added Due to Stabilization		
		Increase 1%	Increase 5%	Increase 7%
This Study Price Supply Response				
Supply Increase	.004	1.004		
	.02		5.021	
	.03			7.0321
Value-Added Supply Response				
Supply Increase	.12	1.1212		
	.60		5.63	
	.84			7.8988
Chin, Pando and West Price Supply Response				
Supply Increase	1.02	2.0302		
	5.10		10.355	
	7.14			14.6398

Table 5.10

CUMULATIVE EFFECT OF STABILIZATION ON
TOTAL REVENUE, EASTERN CANADA, SHORT-RUN

Supply Response to Increased Prices and Value-Added Calculated from Short-Run Elasticities (percent)		Hypothesized Increase in Price and Value-Added Due to Stabilization		
		Increase 1%	Increase 5%	Increase 7%
This Study Price Supply Response				
Supply Increase	.15	1.1515		
	.75		5.7875	
	1.05			8.1235
Value-Added Supply Response				
Supply Increase	.07	1.0707		
	.35		5.3675	
	.49			7.5243
Chin, Pando and West Price Supply Response				
Supply Increase	.39	1.3939		
	1.95		7.0475	
	2.59			9.7713
Zwart and Martin Price Supply Response				
Supply Increase	.22	1.2222		
	1.10		6.155	
	1.54			8.6478

Table 5.11

CUMULATIVE EFFECT OF STABILIZATION ON
TOTAL REVENUE, EASTERN CANADA, LONG-RUN

Supply Response to Increased Prices and Value-Added Calculated from Long-Run Elasticities (percent)		Hypothesized Increase in Price and Value-Added Due to Stabilization		
		Increase 1%	Increase 5%	Increase 7%
This Study Price Supply Response				
Supply Increase	.58	1.5858		
	2.90		8.045	
	4.06			11.3442
Value-Added Supply Response				
Supply Increase	.27	1.2727		
	1.35		6.4175	
	1.89			9.0223
Chin, Pando and West Price Supply Response				
Supply Increase	.87	1.8[illegible]7		
	4.35		9.5675	
	6.09			13.5163
Zwart and Martin Price Supply Response				
Supply Increase	.89	1:8989		
	4.45		9.6725	
	6.23			13.6661

Table 5.12

CUMULATIVE EFFECT OF STABILIZATION ON
TOTAL REVENUE, WESTERN CANADA, SHORT-RUN

Supply Response to Increased Prices and Value-Added Calculated from Short-Run Elasticities (percent)		Hypothesized Increase in Price and Value-Added Due to Stabilization: Increase 1%	Increase 5%	Increase 7%
This Study Price Supply Response				
Supply Increase	.06	1.0606		
	.30		5.315	
	.42			7.4494
Value-Added Supply Response				
Supply Increase	.07	1.0707		
	.35		5.3675	
	.49			7.5243
Chin Pando and West Price Supply Response				
Supply Increase	.40	1.404		
	2.00		7.1	
	2.80			9.996
Zwart and Martin Price Supply Response				
Supply Increase	.10	1.101		
	.50		5.525	
	.70			7.749

Table 5.13

CUMULATIVE EFFECT OF STABILIZATION ON
TOTAL REVENUE, WESTERN CANADA, LONG RUN

Supply Response to Increased Prices and Value-Added Calculated from Short-Run Elasticities (percent)		Hypothesized Increase in Price and Value-Added Due to Stabilization		
		Increase 1%	Increase 5%	Increase 7%
This Study Price Supply Response				
Supply Increase	.15	1.1515		
	.75		5.7875	
	1.05			8.1235
Value-Added Supply Response				
Supply Increase	.17	1.1717		
	.85		5.8925	
	1.19			8.2733
Chin, Pando and West Price Supply Response				
Supply Increase	.85	1.8585		
	4.25		9.4625	
	5.95			13.3665
Zwart and Martin Price Supply Response				
Supply Increase	.20	1.202		
	1.00		6.05	
	1.40			8.498

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

Summary

In Chapter I three hypotheses were postulated.

1) That gross income fluctuations from hog production have been caused, for the most part, by supply variability.
2) That hog stabilization programs in Canada have been basically price support programs and have not been truly stabilizing in nature.
3) That hog stabilization programs have generally been ineffective due to the fact that they have concentrated on stabilizing price rather than on the major hypothesized cause of income variations-- supply variability.

In Chapter IV an attempt was made to examine the first hypothesis by estimating the percentage variability in annual gross income which would be directly attributed to price variations and that percentage which appears to be caused directly by quantity variations. The results of this analysis suggested that over twenty-four years (1950-1973) a greater portion of gross income variability stemmed directly from price variability. For example, the proportion of variability in gross income from hog production which is directly attributable to price variations was 75 percent in Canada, 71 percent in Alberta, 75 percent in Eastern Canada and 62 percent in Western Canada for the years 1950 to 1973. A comparable set of results were found from the analysis of variability in annual gross income from cattle and calf production over the same years.[1]

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[1] See Tables 4.10 and 4.11, Chapter IV.

The analysis of week-to-week data, however, suggested that supply fluctuations contributed relatively more to income variability for hog producers and for cattle and calf producers than did price fluctuations (see Table 4.17, Chapter IV).

The second hypothesis was examined in Chapter II, which briefly described some hog stabilization programs in Canada. In practice, most hog stabilization programs have been "stop-loss" or deficiency payment programs. In most cases the programs were set up on an ad hoc basis to offset the losses being experienced by the hog producers. Only the Joint Maritime Hog Stabilization program, of which Prince Edward Island is a member, set up a fund of money into which producers paid when times were good and were paid out of when times were bad. In addition, the Maritime plan has lasted a number years, which is longer than other hog stabilization plans. The Maritime plan is based on minimum government contribution and can be considered to be close to a true stabilization program.[1] The Federal Government's hog stabilization program of 1974-1975, which utilized the so-called "value-added" approach, was a stop-loss program. It could not be considered a stabilization program in the true sense of the word.

The testing of the third hypothesis, undertaken in Chapters IV and V, yielded mixed results. First, the analysis of the variability of annual gross income over twenty-four years resulted in the conclusion that price variability was the major cause of aggregate income variability from year to year. Thus, any price stabilization program should be

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[1] The Prince Edward Island government will provide to the fund an interest-free loan when the fund is depleted. Only in times when low hog prices have drained the fund and the loan will the government step in and provide grants to the fund to maintain the payouts.

directly effective in reducing the variability, hog producers annual gross income. However, the results of the analysis of weekly data suggested that supply fluctuations were the major contributor to the variability of hog producers aggregate income. The latter feature suggests that any price stabilization program can only be indirectly effective in stabilizing short-run fluctuations in gross income. The degree by which a price stabilization program could be indirectly effective is based on the price elasticity of supply of hog production. That is, if hog producers production decisions were very influenced by the changing levels of hog prices, then stabilizing hog prices would lead to stable hog supplies and utimately to stable gross incomes. If, however, hog production decisions were not strongly influenced by changing levels of hog prices, then a price stabilization program would be relatively ineffective in stabilizing hog producers gross income variability.

In Chapter V, the results of the regression analyses for Canada, Alberta, Eastern Canada and Western Canada hog production functions were outlined. It was found that the price of index 100 hogs was an insignificant variable in the Western Canada and Alberta hog supply functions. That meant that the changing levels of prices of index 100 hogs in the two regions did not explain a great deal of the changes in the levels of hog slaughter. From that result, it may be postulated that hog producers in Alberta and Western Canada tended to base their hog production decisions on some other criteria than hog price changes. If this were to hold true over the period under consideration, a hog price stabilization would have little effect on stabilizing supply. Hence, none of the hog price stabilization programs, are likely to have had much

indirect stabilizing influence on the aggregate income of hog producers in Alberta and Western Canada. This conclusion was reinforced by the calculated total revenue impacts presented in Chapter V.

The analysis of the Federal Government's hog stabilization program of 1974-1975 showed that the effect of the program on hog producers' net income, had the market margin fallen below the program margin of $22.41 per hundredweight, would likely have been minimal. The estimated "value-added" elasticities were generally low, thus a "value-added" stabilizing program for hog producers would have elicited only a small response. Therefore, the "value-added" program would have had little indirect stabilizing influence on hog producers' net income. In addition, this stabilization program only lasted for one year and payments were not made at the time when the calculated market margin, the difference between hog prices and feed costs, fell below $22.41 per hundredweight. Thus, the program was not stabilizing for those producers who sold hogs during the months when hog prices were low.[1]

Recommendations

For Research

This study wasnecessarily a preliminary one. Future research should be directed in the following directions:

1) It is recommended that research be undertaken to ascertain the effects of any Federal Government stabilization programs on the provinces.

2) It is recommended that research be undertaken to ascertain the costs and benefits of any stabilization programs.

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[1] See Table 2.1, Chapter II.

3) It is recommended that using a cross-sectional approach, research be undertaken to ascertain the effect of any stabilization program's on producers' income expectations and their subsequent production decisions.

4) It is recommended that research be undertaken to ascertain the effectiveness of stabilizing programs which operate outside the market place (eg. income averaging for income tax purposes) with respect to stabilizing the supply of agricultural products.

5) It is recommended that research be undertaken to ascertain the effects on investment planning brought about by any stabilization program.

For Government Programs

It is recognized that a stabilization policy, while being theoretically sound, may be politically difficult to introduce. However, it is felt that a stabilization policy should incorporate a number of facets to meet both the necessary theoretical considerations and the rigors of an actual application of that policy. It is recommended that government policies take into account the following facets:

1) It is felt that differences in regional production practices are sufficiently large to mitigate against the use of national stabilization programs based on a national average cost of production formula, (to determine a floor price). Thus, stabilization programs should be designed to account for these regional differences in production practises while maintaining the most economic patterns of production.

2) Stabilization programs should be of sufficient length in duration so that if the stabilization policy increases prices and leads

to a positive production response (the extent of the production response being dependent upon the price elasticity of supply), that the price of the commodity does not fall to a level below that which could have been expected had there been no stabilization policy. That is, the stabilization policy must not in itself be a destabilizing influence by being of only short duration.

3) Stabilization policies must take into account as many destabilizing influences as possible. That is, if feed costs are a major destabilizing influence on producers' net income, then the policy should work to offset that destabilizing influence.

4) Examination of the Federal government's hog stabilization program leads to the recommendation that stabilization policies should not be based on annual averages but on a quarterly basis. In Chapter II, it was shown that the market margin had fallen below the guaranteed margin of $22.41. If the program had been run on a quarterly basis, it is possible that producers selling hogs at that time would have received some benefit from the program.

5) It is also felt that stabilization programs should be designed to adhere as closely as possible to theoretical stabilization programs (eg. the buffer fund and buffer stock programs) with a minimum of government contribution. This recommendation is based on the reasoning that when a government contributes to the producer, the program is no longer a stabilizing program in the true sense of the word, unless the government gets repaid at a later date. Rather, the program becomes a transfer of funds from taxpayers to producers. The transfer of funds between sectors would lead to a positive production response which may in turn lead to lower prices and the necessity for greater government support.

On the basis of the foregoing chapters and analysis, it is felt that hog stabilization programs in Canada should be refined so as to be more effective in reducing hog producers' uncertainty. In addition, it is felt that research should be undertaken to ascertain the type of stabilization program which best suits the characteristics (regional marketing and production practices) of the various agricultural commodities in Canada.

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APPENDIX A

THE BAUER AND PAISH FORMULA

The Bauer and Paish formula for crops involves two steps, the first being the calculation of total pay-out or pay-in under the scheme, the second being the calculation of the price per ton to be paid.

(1) Pay-out or Pay-in.

$$I_t = \frac{Y_t}{x} + \frac{1}{n}\left[Y_{t-1} + Y_{t-2} + \ldots + Y_{t-n} + \frac{x-1}{x}\right] \text{ where}$$

I_t = total amount distributed to producers in current year t.

Y_t = proceeds of crop for current year.

$\frac{1}{x}$ = fraction of proceeds for current year paid to producer.

n = number of years over which proceeds are averaged.

(2) Calculation of Price

$$S_t = \frac{\frac{\bar{P}t}{x} + \frac{1}{n}\left[P_{t-1}Q_{t-1} + P_{t-2}Q_{t-a} + \ldots + P_{t-n}Q_{t-n} + \frac{\bar{P}_{t-1}Q_{t-1} + P_{t-2}Q_{t-2} + \ldots + \bar{P}_{t-n}Q_{t-n}}{x}\right]}{\bar{Q}_t}}{\bar{Q}_t}$$

S_t = producer price.

P = market price (net proceeds per ton).

$\bar{P}$ = expected market price (net proceeds per ton).

Q = volume of crop.

$\bar{Q}$ = expected volume of crop.

$\frac{1}{x}$ = fraction of expected proceeds of current year paid-out.

n = number of years over which proceeds are averaged for smoothing fluctuations.

APPENDIX B

SUPPLY FUNCTIONS ESTIMATED BY CHIN, PANDO AND WEST, AND BY ZWART AND MARTIN

Table B.1

SUPPLY FUNCTIONS ESTIMATED BY CHIN, PANDO AND WEST

	Regression Coefficients (t - statistic in brackets)								
Region	Inter-cept	D	Qt-1	Pt-3	Ct-3	G_{t-2}	PCt-3	T	R^2
Canada	273.404	-214.67	.409	53.32	3.75	.032		24.93	.93
	(.33)	(2.57)	(3.87)	(3.42)	(.16)	(2.42)		(2.92)	
Alberta	57.854	-163.08	.59	13.31	2.54	.26			.81
	(.41)	(4.85)	(.427)	(2.40)	(.35)	(2.06)			
Eastern Canada	716.705		.55	34.77	-13.23		-9.56	13.34	.95
	(2.88)		(4.07)	(5.42)	(1.90)		(2.21)	(2.14)	
Western Canada	222.21	270.95	53	23.42	7.43	.032			.93
	(.96)	(4.14)	(4.31)	(2.26)	(.48)	(3.39)			

Table B.2

SUPPLY FUNCTIONS ESTIMATED BY ZWART AND MARTIN

Region	Inter-cept	PH_{t-5}	PF_{t-5}	FS_{t-5}	B PD_{t-5}	Q_{st-1}	R^2
			(t - statistics in brackets)				
Eastern Canada							
1st Quarter	8.97	1.08	-.09		-.45	.75	.96
2nd Quarter	1.38	(4.49)	(-.33)		(-.54)	(8.06)	
3rd Quarter	7.28						
4th Quarter	18.78						
Western Canada							
1st Quarter	27.32	.369		1.06	-3.61	.49	.96
2nd Quarter	21.90	(1.05)		(2.73)	(3.01)	(4.96)	
3rd Quarter	3.76						
4th Quarter	27.16						